Nevada and Northeastern California Greater Sage-Grouse

Proposed Land Use Plan Amendment and Final Environmental Impact Statement

BLM

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The Bureau of Land Management's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

The mission of the USDA Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.

BLM/NV/NV/ES/15-09+1793

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Appendix A

Greater Sage-Grouse Habitat Map for Nevada and Northeastern California Land Use Plan Amendment

APPENDIX A
GREATER SAGE-GROUSE HABITAT MAP FOR NEVADA AND NORTHEASTERN CALIFORNIA LAND USE PLAN AMENDMENT

INTRODUCTION

Throughout the planning process, the Bureau of Land Management (BLM) has identified the effects of the proposed Land Use Plan Amendment based on the degree and amount of impact to greater sage-grouse habitat. This document provides a 'history' of that process, with the intent being to demonstrated how the delineation of habitat has evolved during the planning process and the rationale for the use of the most current habitat mapping effort in the final plan amendment.

HISTORY ON HABITAT IDENTIFICATION WITHIN THE NEVADA/NE CALIFORNIA SUB-REGION

Planning

A key element of the BLM strategy for the conservation of the Greater Sage-grouse (GRSG) is a scientific based delineation of the habitat it uses. The identification process in the Nevada-Northeastern California Sub-region has been a combination of habitat characteristics desired by GRSG during various annual life cycles and actual use by the species. It is acknowledged in the BLM process, as well in the scientific literature, that there is a hierarchy categorization of the habitat in regards to importance and use by GRSG. The need for identification of important habitat, as well as maintaining these areas, is summarized in the US Fish and Wildlife Service 2010 Findings regarding the listing of GRSG. As stated in their findings:

"Sage-grouse exhibit strong site fidelity (loyalty to a particular area even when the area is no longer of value) to seasonal habitats, which includes breeding, nesting, brood rearing, and wintering areas (Connelly et al. 2004, Connelly et

> *al. 2011b). Adult sage-grouse rarely switch between these habitats once they have been selected, limiting their adaptability to change"*

Thus ensuring the conservation and protection of the most important habitat, in terms of use and quality, is paramount in the agency's ability to sustain the GRSG population.

The National Technical Team (NTT) report identified that the overall goal for the BLM is development of regulatory mechanisms (Management Actions and Allocations) to protect priority GRSG habitat from human caused disturbances. The continuation of these anthropogenic disturbances could result in the reduction in distribution and abundance of GRSG. The report also acknowledged the need to delineate other habitat (general) so as to provide for the connectivity between areas of high use (priority habitat).

The NTT Report provided the following definitions:

> **Priority Sage-grouse Habitat:** Areas that have been identified as having the highest conservation value to maintaining sustainable sage-grouse populations. These areas would include breeding, late brood-rearing, and winter concentration areas. These areas have been identified by state fish and wildlife agencies in coordination with respective BLM offices.
>
> **General Sage-grouse Habitat:** Is occupied (seasonal or year-round) habitat outside of priority habitat. These areas have been identified by state fish and wildlife agencies in coordination with respective BLM offices.

In December 27, 2011, the BLM issued Instruction Memorandum (IM) No. 2012-044 which provided field offices with direction regarding the Land Use Planning strategy for completing the analysis for land use plan amendments for the conservation of GRSG. The IM includes direction regarding habitat identification and delineations. Key points in the IM regarding habitat were:

1) Identification of a science based habitat map in coordination with state wildlife agencies for Preliminary Priority and General Habitat (PPH and PGH)
2) Refinement, through a science based approach, of the PPH and PGH through the planning process.
3) In those instances where the BLM State Offices have not completed this delineation, the Breeding Bird Density maps developed by Doherty 2010 would be used.

4) The IM defined PPH and PGH as follows:

   Preliminary Priority Habitat (PPH): Areas that have been identified as having the highest conservation value to maintaining sustainable Greater Sage-Grouse populations. These areas would include breeding, late brood-rearing, and winter concentration areas. These areas have been/are being identified by the BLM in coordination with respective state wildlife agencies.

   Preliminary General Habitat (PGH): Areas of occupied seasonal or year-round habitat outside of priority habitat. These areas have been/are being identified by the BLM in coordination with respective state wildlife agencies.

In December 2012, the Nevada Department of Wildlife (NDOW) issued their GRSG habitat Categorization maps. This categorization were based on 1) BLM sagebrush habitat mapping, 2) incorporation of lek data (75% Core Breeding density dataset developed by Doherty et. al; 2010) and 3) adjustments based upon recent vegetation data, telemetry data, and local biologist knowledge. The effort was accomplished through a GIS process.

NDOW identified five (5) categories in addition to non-habitat. These categories are identified in **Table A-1**:

Table A-1
NDOW Categorization Habitat

Category	Habitat Value	Life Cycle Use
1	Essential/Irreplaceable	Lek and associated nesting habitat
2	Important Habitat	Brood rearing and winter habitat
3	Habitat of Moderate Importance	Habitats having meaningful potential but generally lack a key component
4	Low Value Habitat and Transitional Range	Habitat that contribute very little to GRSG
5	Unsuitable Habitat	Non-Habitat unless significant restoration is accomplished

In their release of the maps, NDOW specifically stated that the maps were for land use planning efforts and should be updated periodically to reflect new information regarding habit conditions and species use.

In March 2012, the BLM issued a press release indicating that the NDOW categorization mapping would be used for delineation of PPH and PGH habitat for GRSG. Essentially, NDOW's Categories 1 and 2 would constitute PPH and Category 3 would delineate PGH. In the release, the BLM invited public comments on the use of the NDOW map as a basis for identification of PPH and PGH as part of the land use planning scoping process. The BLM received no substantive comments regarding the use NDOW categorization map.

On public lands administered by the California BLM, delineation of the PPH and PGH was based on 1) 75% and 100% Breeding Density mapping, 2) definitions identified in the NTT Report, 3) existing disturbances and/or uses 4) telemetry data, and 5) local biological knowledge.

Draft Land Use Plan Amendment and Environmental Impact Statement

The Draft LUPA/EIS identified a range of alternatives for management of priority, general, and un-mapped habitat. The "unmapped habitat" was defined as sage-grouse habitat within the planning area that is not considered to be Priority or General habitat, but where GRSG use has been observed or suspected. The Draft LUPA/EIS Alternative D analyzed all unmapped habitat and Required Design Features. The Draft LUPA/EIS analyzed 6 alternatives, including a No Action Alternative (A), an alternative based on the National Technical Team Report (NTT Report) (B), two citizen-based alternatives (C and F), the agency's preferred alternative (D), and an alternative based on proposals from the State of Nevada(E).

Table A-2 displays the acres of priority and general habitat that were identified in each of the alternatives. Alternative E was provided by the State of Nevada and did not cover all GRSG Habitat. It also had different management categories than the other alternatives.

Table A-2
Habitat Acres in the Draft LUPA/EIS (BLM & FS)

	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Priority	12,693,500	17,732,900	12,927,400	10,655,300 (Occupied)	12,693,500
General	5,039,400		4,805,500	2,295,500 (Suitable)	5,039,400
Unmapped	32,135,700	32,135,700	32,135,700	2,432,200 (Potential)	32,135,700
Total	49,868,600	49,868,600	49,868,600	15,383,000	49,868,600

In the Draft LUPA/EIS, management actions and allocations ranged from prohibition (Closed, No Surface Occupancy (NSO), and Exclusion); Restricted Use (Avoidance; NSO with exemption, modification or waivers; and limited), or unrestricted (open). These management actions were applied to either or both PGH and PPH depending on the Alternative, with the most restrictive actions being applied to PPH. The range of actions varied from no restrictions (generally the No Action Alternative) to complete prohibition of all actions.

The Preferred Alternative (Alternative D) in the Draft LUPA/EIS included management actions that acknowledged the need to adjust habitat delineation based on new information.

The Nevada State Alternative (Alternative E) also identified the potential for adjustment to the habitat delineation. Specifically:

> **Sub-Objective E-SSS 3**: SGMAs include Occupied Habitat, Suitable Habitat, Potential Habitat, and Non Habitat, as defined in the State of Nevada 2012. The Nevada Sagebrush Ecosystem Council – through field verifications and recommendations from the Nevada Sagebrush Ecosystem Technical Team based on the best available science – will further refine the habitat categories within the SGMAs. Also, it is understood that the final nomenclature for these habitat categories may vary.

To ensure all GRSG habitats were adequately conserved, the Draft LUPA/EIS (Alternative D) provides the following direction to unmapped habitat:

> **Action D-SSS 7:** Implement the RDFs (Required Design Features) in areas outside of mapped PPMA and PGMA where GRSG use has been observed or suspected, areas and habitats which may be necessary to maintain viability of GRSG, or where the activity would affect GRSG or their habitat in PPMA or PGMA.

In the issuance of the Draft LUPA/EIS for public comment, the BLM specifically requested that public provide comments on all Management Actions, regardless of the Alternative as the final proposed plan amendment could include elements from any of the alternatives not just the preferred (Alternative D). Public comments included requests for incorporating updated science and mapping, specifically the *Spatially Explicit Modeling of GRSG Habitat in Nevada and Northeast California* (Coates et al 2014).

Updated Habitat Map

In October 2014, BLM received a final version of the Management Categories for Greater Sage-grouse in Nevada and California (August 2014) from the State of Nevada. This map (hereinafter referred to as the updated map) is based on the GRSG habitat suitability modeling by the USGS (Coates et. al 2014a). The updated map was prepared in cooperation with Dr. Peter Coates with USGS, the States of Nevada and California, and the BLM. The updated map underwent peer review and is considered by the State, USGS, and the BLM as the best available science on location and suitability of sage grouse habitat in Nevada and northeastern California. The mapping effort incorporated updated telemetry data (1998-2013), landscape habitat mapping (which includes vegetation mapping as well as topography and land features) and GRSG lek data. The State of Nevada has requested that the updated map should be included in Alternative E.

The USGS approach identified a habitat suitability index based on telemetry data and landscape habitat mapping. The habitat suitability was then characterized for importance to GRSG as high, moderate, low or non-habitat. A Space Use Index (SUI) was developed based on lek attendance and density coupled with probability of sage-grouse occurrence relative to distance to nearest lek. The SUI was then intersected with the habitat suitably index to identify management categories for GRSG planning efforts as outlined below. Please reference Coates et al. 2014a for complete methods.

The categories identify are:

Core Areas: Defined as the intersection between all suitable habitats (high, moderate, and low categories) and the high use category. This habitat management class is intended to incorporate all suitable habitats that have relatively high certainty of current sage-grouse occupancy.

Priority Areas: Defined as both high suitability habitat that is present within the low-to-no use category and non-suitable habitat occurring within the high use category. This habitat management class encompasses: (1) high-quality habitats based on environmental covariates with a lower potential for occupancy given the current distribution of sage-grouse; and (2) sage-grouse incursion into areas of low quality habitat that is potentially important for local populations (for example, corridors of non-habitat connecting higher quality habitat).

General Areas: Defined as moderate and low habitat suitability that is present within the low-to-no use SUI category. This habitat management class represents areas with appropriate environmental conditions for sage-grouse, but is less frequently used by sage-grouse.

Non-habitat Areas: Defined as non-suitable habitat that is present within the low-to-no use SUI. This scenario represents habitat of marginal value to sage-grouse populations.

Discussion Regarding the Use of the Update Map for GRSG Habitat Identification in Final Environmental Impact Statement

Comparison

The updated map's definitions and identification of Core and Priority habitat areas are consistent with the Draft LUPA/EIS' definitions and identification of priority and general habitat areas, respectively. The updated map's definition and identification of General habitat areas is consistent with the Draft LUPA/EIS' identification of the remainder of the planning area, referred to in the Draft LUPA/EIS as "unmapped" areas.

The basis for each mapping effort was current telemetry data, vegetation/habitat and use (i.e. lek information). These are the same factors used by NDOW in the original Habitat Categorization Map. However, the updated map used a more robust modeling process.

Table A-3 is a general comparison of the respect habitat delineations for each process.

Table A-3
Comparison of Habitat Categories

Updated Map Categories of Habitat	Draft LUPA/EIS Categories of Habitat
Core: The intersection between all suitable habitats (high, moderate, and low categories) and the high use category. This habitat management class is intended to incorporate all suitable habitats that have relatively high certainty of current sage-grouse occupancy.	Priority (P): Areas that have been identified as having the highest conservation value to maintaining sustainable GRSG populations. These areas include breeding, late brood-rearing and winter concentration areas.
Priority: Includes both high suitability habitat that is present within the low-to-no use category and non-suitable habitat occurring within the high use category. This habitat management class encompasses: (1) high-quality habitats based on environmental covariates with a lower potential for occupancy given the current distribution of sage-grouse; and (2) sage-grouse incursion into areas of low quality habitat that is potentially important for local populations (for example, corridors of non-habitat connecting higher quality habitat).	General (G): Areas of occupied seasonal or year-round habitat outside of PPH.
General: Moderate and low habitat suitability that is present within the low-to-no use category. This habitat management class represents areas with appropriate environmental conditions for sage-grouse, but is less frequently used by sage-grouse.	Un-mapped (U): Areas outside of mapped PPH and PGH where GRSG use has been observed or suspected, areas and habitats which may be necessary to maintain viability of GRSG, or where the activity would affect GRSG or their habitat in PPH or PGH.
Non-habitat: Non-suitable habitat that is present within the low-to-no use categories. This scenario represents habitat of marginal value to sage-grouse populations.	

Table A-4 compares the acreage habitat according to the updated map and the acreages of habitat as set forth in the range of alternatives in the Draft LUPA/EIS.

As reflected in **Table A-4**, the acreage identified in the new map are quantitatively within the range of acreages that were analyzed in the Draft LUPA/EIS.

The Draft LUPA/EIS contains management direction for over 49 million acres of land administered by BLM and Forest Service. The action alternatives in the Draft LUPA/EIS provide a range of acreages that would be subject to priority

Table A-4
Comparison of Original Habitat Map with Updated Habitat Map

Updated Map		Alternative B		Alternative C		Alternative D		Alternative E		Alternative F	
Core	9,573,300	PPH	12,693,500	PPH	17,732,900	PPH	12,927,400	Occup.	10,655,300	PPH	12,693,500
Priority	6,953,300	PGH	5,039,400	PGH	-----	PGH	4,805,500	Suitable	2,295,500	PGH	5,039,400
Total	**16,526,600**		**17,732,900**		**17,732,900**		**17,732,900**		**12,950,800**		**17,732,900**
General	6,709,100					Un-Mapped	32,135,700	Potent.	2,432,200		
Total	**23,235,700**						**49,868,600**		**15,383,000**		
Non-habitat	11,254,500							Non-habitat	522,600		
Total	**34,490,200**								**15,905,600**		

and general management actions. In addition, Alternatives D identified areas as "unmapped" habitat, and required design features (RDFs) would be implemented (Action D-SSS 7). Stated differently, the total acreage of "unmapped" areas where RDFs would be imposed is the difference between the entire planning area (approximately 49 million acres) and priority and general habitat areas (approximately 17.7 million acres), or approximately 32,000,000 acres. Under the No Action alternative (A), no public lands were designated by BLM as priority or general, nor were any specific areas or acreages (0 acres) identified as "unmapped" habitat that would be subject to the RDFs as in the action alternatives (**Action D-SSS-AM 9)**.

Map Refinements Acknowledged

As identified above, one of the goals of the Draft LUPA/EIS was to "ensure additional PPMA and PGMA is identified based upon new science, monitoring of PPMA [priority habitat] and PGMA [general habitat]." One of the management actions for Alternative D stated that "GRSG habitat categorization and use management boundaries would be evaluated and adjusted based on continuing inventory and monitoring results every five years. Adjustments up to plus or minus ten percent of the mapped habitat within the population management zone would be made without further analysis" **(Action D-SSS-AM 9**). Alternative E similarly stated that "through field verifications and recommendations from the Nevada Sagebrush Ecosystem Technical Team based on the best available science – will further refine the habitat categories within the...[State, including]…Occupied Habitat, Suitable Habitat, Potential Habitat, and Non Habitat, as defined in the State of Nevada 2012 Plan" **(Sub-Objective E-SSS 3)**. Further, Alternative D specifically stated that a protocol will be established "for incorporating new science and changes over time, to update and keep State-wide habitat maps current." **(Action D-SSS-AM 1**)

The revised map was developed using the same parameters that were used in development of the original habitat map for the Draft LUPA/EIS. Specifically, both mapping efforts were based on vegetation conditions (habitat suitability) and known GRSG distribution and use. The primary difference between the maps is the level of knowledge of both the above parameters. No new attribute was used in the development of the revised map that could significantly change the area of use by the GRSG.

The Land Use Plan Amendment identifies management actions and allocations that are applied to the specific habitat and the Draft LUPA/EIS describes the effects of the application of the management actions and allocations. The revised habitat map would not result in new decisions or environmental effects that were not considered and disclosed in the Draft LUPA/EIS.

In addition, the revised map identified priority, general, and unmapped habitat acres that are generally within the range of habitat disclosed in the Draft LUPA/EIS and encompasses the same area that was identified during the Draft LUPA/EIS public comment period.

Conclusion

In conclusion, the BLM's use of the revised habitat map as to all categories of habitat identified is both quantitatively and qualitatively addressed in the alternatives analyzed in the Draft LUPA/EIS.

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Appendix C

Response to Comments on the Draft Land Use Plan Amendment/Environmental Impact Statement

APPENDIX C
RESPONSE TO COMMENTS ON THE DRAFT LAND USE PLAN AMENDMENT/ENVIRONMENTAL IMPACT STATEMENT

C.1 INTRODUCTION

After publishing the Draft Land Use Plan Amendment (LUPA)/Environmental Impact Statement (EIS), the Bureau of Land Management (BLM) and Forest Service held a 90-day public comment period to receive comments on the Draft LUPA/EIS. The BLM and Forest Service received written comments on the Draft LUPA/EIS by mail, email, and submissions at the public meetings and oral comments transcribed at public meetings. Comments covered a wide spectrum of thoughts, opinions, ideas, and concerns. The BLM and Forest Service recognize that commenters invested considerable time and effort to submit comments on the Draft LUPA/EIS and developed a comment analysis methodology to ensure that all comments were considered, as directed by National Environmental Policy Act (NEPA) regulations.

According to NEPA, the BLM and Forest Service are required to identify and formally respond to all substantive public comments. The BLM and Forest Service developed a systematic process for responding to comments to ensure all substantive comments were tracked and considered. Upon receipt, each comment letter was assigned an identification number and logged into the BLM's comment analysis database, CommentWorks, which allowed the BLM and Forest Service to organize, categorize, and respond to comments. Substantive comments from each letter were coded to appropriate categories based on the content of the comment, retaining the link to the commenter. The categories generally follow the sections presented in the Draft LUPA/EIS, though some relate to the planning process or editorial concerns.

Comments similar to each other were grouped under a topic heading, and the BLM and Forest Service drafted a statement summarizing the issues contained in the comments. The responses were crafted to respond to the comments, and, if warranted, a change to the EIS was made.

Although each comment letter was diligently considered, the comment analysis process involved determining whether a comment was substantive or nonsubstantive in nature. In performing this analysis, BLM and Forest Service relied on the Council on Environmental Quality's (CEQ) regulations to determine what constituted a substantive comment.

A substantive comment does one or more of the following:

- Questions, with a reasonable basis, the accuracy of the information and/or analysis in the Draft LUPA/EIS
- Questions, with a reasonable basis, the adequacy of the information and/or analysis in the Draft LUPA/EIS
- Presents reasonable alternatives other than those presented in the Draft LUPA/EIS that meet the purpose and need of the proposed action and address significant issues
- Questions, with a reasonable basis, the merits of an alternative or alternatives
- Causes changes in or revisions to the proposed action
- Questions, with a reasonable basis, the adequacy of the planning process itself

Additionally, the BLM's NEPA Handbook (H-1790-1) identifies the following types of substantive comments:

- <u>Comments on the Adequacy of the Analysis</u>: Comments that express a professional disagreement with the conclusions of the analysis or assert that the analysis is inadequate are substantive in nature but may or may not lead to changes in the Proposed LUPA/Final EIS. Interpretations of analyses should be based on professional expertise. Where there is disagreement within a professional discipline, a careful review of the various interpretations is warranted. In some cases, public comments may necessitate a reevaluation of analytical conclusions. If, after reevaluation, the manager responsible for preparing the EIS (Authorized Officer) does not think that a change is warranted, the response should provide the rationale for that conclusion.
- <u>Comments That Identify New Impacts, Alternatives, or Mitigation Measures</u>: Public comments on a Draft EIS that identify impacts, alternatives, or mitigation measures that were not addressed in the

draft are substantive. This type of comment requires the Authorized Officer to determine whether it warrants further consideration. If it does, the Authorized Officer must determine whether the new impacts, new alternatives, or new mitigation measures should be analyzed in the Final EIS, a supplement to the Draft EIS, or a completely revised and recirculated Draft EIS.

- Disagreements with Significance Determinations: Comments that directly or indirectly question, with a reasonable basis, determinations regarding the significance or severity of impacts are substantive. A reevaluation of these determinations may be warranted and may lead to changes in the Final EIS. If, after reevaluation, the Authorized Officer does not think that a change is warranted, the response should provide the rationale for that conclusion.

Comments that failed to meet the above description were considered nonsubstantive. Many comments received throughout the process expressed personal opinions or preferences, had little relevance to the adequacy or accuracy of the Draft LUPA/EIS, represented commentary regarding resource management and/or impacts without any real connection to the document being reviewed, or were considered out of scope because they dealt with existing law, rule, regulation, or policy. These comments did not provide specific information to assist the planning team in making changes to the alternatives or impact analysis in the Draft LUPA/EIS and are not addressed further in this document. Examples of nonsubstantive comments include the following:

- The best of the alternatives is Alternative D (or A, B, or C).
- The preferred alternative does not reflect balanced land management.
- More land should be protected as wilderness.
- BLM needs to change the Taylor Grazing Act and charge higher grazing fees.
- I want the EIS to reflect the following for this area: no grazing, no logging, no drilling, no mining, and no Off-Highway Vehicles (OHVs).
- More areas should be made available for multiple uses (e.g., drilling, OHVs, and right-of-ways [ROWs]) without severe restrictions.

Opinions, feelings, and preferences for one element or one alternative over another, and comments of a personal and/or philosophical nature, were all read, analyzed, and considered. However, because such comments are not substantive in nature, the BLM and Forest Service did not include them in the report and did not respond to them. While all comments were reviewed and considered, comments were not counted as "votes." The NEPA public comment period is neither considered an election, nor does it result in a representative sampling of the population. Therefore, public comments are not appropriate to be used as a democratic decision-making tool or as a scientific sampling mechanism.

Comments citing editorial changes to the document were reviewed and incorporated.

Copies of all comment documents received on the Draft LUPA/EIS are available by request from the BLM's Nevada and California State Offices. Comments received by mail, email, and at meetings, or delivered orally during the public meetings, are tracked by commenter name and submission number.

C.1.1 Campaign Letters

Several organizations and groups held standardized letter campaigns for the Greater Sage-Grouse (GRSG) effort through which their constituents were able to submit the standard letter or a modified version of the letter indicating support for the group's position on the BLM and Forest Service LUPA actions. Individuals who submitted a modified standard letter generally added new comments or information to the letter or edited it to reflect their main concern(s). Modified letters with unique comments were given their own letter number and coded appropriately. All commenters who used an organization's campaign letter were tracked in the BLM and Forest Service commenter list and are available from the BLM and Forest Service upon request.

C.1.2 How This Appendix is Organized

This appendix is divided into three main sections. The first section, Introduction, provides an overview of the comment-response process. The second section, Issue Topics, Responses, and Comments, is organized by the primary topic and then by specific issue subtopics that relate to an aspect of NEPA, the BLM and Forest Service planning processes, or specific resources and resource uses. For example, all comment summaries that relate to aspects of the alternatives fall under the heading, "1.2.2 Alternatives." This includes subsections such as Design Features and Best Management Practices, the Elimination Criteria, and any of the alternatives. Comments summaries and responses for baseline information (such as the information found in **Chapter 3**, Affected Environment) and impact analysis (**Chapter 4**) are found under the respective resource topic. For example, comment summaries and responses related to the affected environment and impact analysis on cultural resources are under the "Cultural Resources" heading. Each topic or subtopic contains a statement that summarizes all substantive comments received on that topic or subtopic and the BLM's and Forest Service's response to the summary statement. Excerpts of all substantive comments are posted on the project website: http://www.blm.gov/nv/st/en/prog/wildlife/greater_sage-grouse.html

The terms preliminary priority management area (PPMA) and preliminary general management area (PGMA) were used in the Draft LUPA/EIS to describe the relative prioritization of areas for GRSG conservation. These are BLM and Forest Service terms used to differentiate the degree of managerial emphasis a given area would have relative to GRSG. As the BLM and Forest Service moved from a Draft EIS to a Proposed LUPA/Final EIS, such prioritizations are no longer "preliminary" in nature. As such, they have been replaced with the terms Priority Habitat Management Area (PHMA) and General Habitat Management Area (GHMA). Comments on the Draft LUPA/EIS referred to PPMA and PGMA. As such, the summary statements also use these terms. However, responses use the terminology used in the Proposed LUPA/Final EIS (PHMA and GHMA).

The third section, Commenter Lists, provides the names of individuals who submitted unique comment letters (not campaign letters) on the Draft LUPA/EIS. Commenters are listed alphabetically by the organization name or commenter's last name.

C.2 Issue Topics, Responses, and Comments

C.2.1 NEPA

General NEPA

Summary

Commenters assert that the Draft LUPA/EIS does not comply with the statutory requirements of the National Environmental Policy Act, and subsequent related case law that combined require agencies involved in preparing environmental documentation to take a "hard look" at the effects of a proposed action, use scientifically sound information, and consider the possible conflicts of a proposed action with other laws, regulations, and planning processes.

Response

The requisite level of information necessary to make a reasoned choice among the alternatives in an EIS is based on the scope and nature of the proposed decisions. As the EIS analyzes land use planning-level decisions, which by their nature are broad in scope, the requisite level of data and information is more generalized in order to apply to a wide-ranging landscape perspective. Although the BLM and the Forest Service realize that more data, and more site-specific data, could always be gathered, the baseline data used in the EIS provide the necessary basis to make informed land use plan-level decisions.

The BLM and the Forest Service considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land-use plan level. The data needed to support broad-scale analysis of the Nevada and northeastern California LUPA planning area are substantially different than the data needed to support site-specific analysis of projects. The LUPA/EIS data and information is presented in map and table form and is sufficient to support the broad-scale analyses required for land use planning.

Additionally, the BLM and the Forest Service used the most recent and best information available that was relevant to a land use planning-level analysis, including the Baseline Environmental Report ([BER]; Manier et al. 2013). The BER assisted the BLM and the Forest Service in summarizing the effects of their planning efforts at a range-wide scale, particularly in the affected environment and cumulative impacts sections. The BER looked at each of the threats to GRSG identified in the US Fish and Wildlife Service's "warranted but precluded" finding for the species. For these threats, the report summarized the current scientific understanding, as of the BER's publication date (June 2013), of various impacts on GRSG populations and habitats. The report also quantitatively measured the location, magnitude, and extent of each threat. These data were used in the planning process to describe threats at other levels, such as the sub-regional boundary and WAFWA Management Zone scale, to facilitate comparison between sub-regions. The BER provided data and information to show how management under different alternatives may meet specific plans, goals, and objectives.

The BLM and the Forest Service consulted with, collected, and incorporated data from other agencies and sources, including but not limited to the US Fish and Wildlife Service, the Nevada Department of Wildlife, and the California Department of Fish and Wildlife. Additional information provided by state and local governments regarding socioeconomics also support the analysis in **Chapters 4** and **5**.

As a result of these actions, the BLM and the Forest Service gathered the necessary data essential to make a reasoned choice among the alternatives analyzed in detail in the Draft LUPA/EIS, and provided an adequate analysis that led to disclosure of the potential environmental consequences of the alternatives (see **Chapter 4,** Environmental Consequences and **Chapter 5**, Cumulative Effects). As a result, the BLM and the Forest Service have taken a "hard look," as required by the NEPA (see 40 CFR 1502.16), at the environmental consequences of the alternatives in the Draft LUPA/EIS to enable the decision maker to make an informed decision.

As noted in more detail in responses to issue statements identified elsewhere in the report, the BLM and Forest Service have complied with the myriad applicable laws, policies, and guidance in developing the LUPA/EIS. **Section 2.5**, Management Common to All Alternatives, of the Draft LUPA/EIS, states that all alternatives would comply with state and federal laws, regulations, policies, and standards, and implement actions originating from laws, regulations, and policies. Additionally, in **Section 1.8.1**, Planning Criteria, of the Draft LUPA/EIS, the BLM has a criterion stating that all alternatives would comply with existing laws, regulations, and policies. The BLM and Forest Service have reviewed all actions in the Proposed LUPA/Final EIS and found them to be consistent and within the bounds of all required laws, regulations, and policies. Further details regarding BLM and Forest Service compliance with state, county, and local plans and policies can be found in **Section 5.2**, Consistency with Other State, County, or Local Plans, of this report.

Public Notification

Summary

The BLM and Forest Service gave inadequate notice to the public about the intent to amend the Land Use Plan and in a manner that identifies the negative impacts on the regional and local economies and cultures.

Response

The BLM and Forest Service provided public notification as required by CEQ 40 CFR 1500-1508, and BLM 43 CFR 1600-1610. A press release was issued in July 2011 announcing a strategy to conserve GRSG and protect its habitat, followed by additional press releases in December 2011. Pursuant to NEPA requirements (40 CFR 1501.7) and BLM Planning Regulations (43 CFR 1610.2 and 1610.4-1), a Federal Register Notice of Intent (NOI) was published on December 9, 2011 announcing the beginning of a 60-day scoping period. The public was invited to participate in scoping meetings throughout the planning area and provide comments during the scoping period, which was scheduled to end on February 7, 2012 but was extended to March 23, 2012. The NOA for the Draft LUPA/EIS was published on November 1, 2013 (78 *Federal Register* 65701, 65702).

Throughout development of this LUPA/EIS, the BLM and Forest Service have provided information through numerous methods, including the Internet, news releases, and social media. Specifically, between July 2011 and April 2014, 19 press releases related to GRSG were issued. They covered a variety of topics, including policy, deferral of parcels in oil and gas lease sales, comment periods, and public workshop announcements. In addition, periodic updates were scheduled in 2014 and 2015 to keep the public up-to-date on the preparation of the Proposed LUPA/Final EIS and were posted to the website.

Contact information is provided on the project website, and interested parties have been encouraged to contact the BLM if they wish. In addition, after the Draft LUPA/EIS was issued the BLM and Forest Service held seven workshops in December 2013 to provide information and answer questions about the Draft

LUPA/EIS. The meetings were announced through press releases to local television, radio, and newspapers.

Potential impacts on local economies and cultures are analyzed in the **Section 4.20**, Socioeconomics and Environmental Justice, of the Proposed LUPA/Final EIS.

Cooperating Agency Relationships

Summary

The BLM and Forest Service did not coordinate with local agencies that would be adversely economically affected by the actions considered in the Draft LUPA/EIS. Additionally, the BLM and Forest Service did not coordinate with Elko County on the development of the Draft LUPA/EIS.

Response

Both the CEQ and BLM planning regulations define cooperating agency status, including what it is, who is eligible to become a cooperating agency, and how the lead agency should invite participation as a cooperating agency (40 CFR 1501 and 1508; 43 CFR 1601.0-5). Cooperating relationships are limited to government entities, state agencies, local governments, tribal governments, and other federal agencies that have jurisdiction by law or special expertise. Additionally, per the regulations and BLM and Forest Service policy, there is no coordinating agency status (see "BLM Desk Guide to Cooperating Agency Relationships and Coordination with Intergovernmental Partners," pages 21 and 31, respectively). To be a cooperating agency, the local agency must meet the eligibility criteria set out in the regulations and policies. The specific role of each cooperating agency is based on jurisdiction by law or special expertise, which is determined on an agency-by-agency basis and identified in the Memorandum of Understanding.

Cooperating agency relationships are described in the Proposed LUPA/Final EIS in **Section 6.3**, Cooperating Agencies. In December 2011, the BLM and Forest Service sent letters to 54 local, state, federal, and tribal representatives inviting them to be cooperating agencies for the LUPA/EIS process. In total, 23 agencies and 10 tribes agreed to participate on the Draft LUPA/EIS as designated cooperating agencies. Of those, 20 agencies and 4 tribes have signed Memoranda of Understanding with the BLM's Nevada or California State Offices (see **Table 6-1**, Cooperating Agencies in **Chapter 6**, Consultation and Coordination).

In addition to the BLM invitations to a wide variety of agencies to participate as cooperating agencies, DOI regulations (43 CFR 46.225(c)) require the BLM, as lead agency, to consider any request by a government entity to participate as a cooperating agency ("BLM Desk Guide to Cooperating Agency Relationships and Coordination with Intergovernmental Partners," pages 8-9). From the time that the Notice of Intent was published and throughout the development of the LUPA/EIS, an agency could notify the BLM requesting cooperating agency status.

All agencies participating as cooperating agencies have been given opportunities to participate during various steps of the planning process, including regular briefings, requests for input on draft alternatives and the administrative Draft LUPA/EIS, and identification of issues and data during scoping and the Draft LUPA/EIS comment periods, as required by 40 CFR 1503.2 and 40 CFR 1506.10. Further, coordination will continue with cooperating agencies in order to identify consistency issues and to be compliant with the relevant laws and regulations. Based on the coordination efforts described above, the BLM and Forest Service have met the legal and regulatory requirements for coordination to date, as described in **Chapter 6**, Consultation and Coordination.

Section 202 of FLPMA requires the BLM and Forest Service, to the extent consistent with the laws governing the administration of the public lands, to coordinate the land use inventory, planning, and management activities of or for such lands with the land use planning and management programs of other federal departments and agencies and of the states and local governments within which the lands are located. The BLM has complied with its requirements to coordinate the development of the Nevada and Northeastern California Sub-regional LUPA with other federal agencies, state and local governments, and Indian tribes pursuant to 43 CFR 1610.3-1. Further, prior to approval of the proposed resource management plan, the BLM will adhere to the consistency requirements of its planning regulations at 43 CFR 1610.3-2.

The BLM and Forest Service considered the proposed alternative submitted by Elko County, but eliminated the plan from detailed analysis. See **Section 2.11.2**, Elko County Plan, for additional information.

Range of Alternatives

Summary

The comments were focused on several issues related to the alternatives presented in the Draft LUPA/EIS:

1. Commenters believed that the preferred alternative does not meet the stated purpose and need.
2. Commenters felt that the alternatives were all largely the same, and that the BLM and Forest Service needed to provide more distinction (range) between the alternatives.
3. BLM and Forest Service need to consider the alternatives presented by Cooperating Agencies and Environmental Organizations, including county

proposed alternatives, the GRSG Recovery Alternative, and alternatives for the listing of the species or not listing the species.

4. The Draft LUPA/EIS fails to fully account for federal regulatory mechanisms that are currently in place and adequately address the threats to the species.

Response

In accordance with NEPA, the BLM and Forest Service have discretion to establish the purpose and need for action (40 CFR 1502.13). CEQ regulations direct that an EIS "…shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action" (40 CFR 1502.13). Also, under the CEQ regulations, the BLM and the Forest Service are required to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by section 102(2)(E) of the Act [NEPA]." (40 CFR 1501.2(c)). The breadth or narrowness of the purpose and need statement has a substantial influence on the scope of the subsequent analysis. The purpose and need statement provides a framework for issue identification and will inform the rationale for alternative selection. The range of alternatives developed and analyzed in the Proposed LUPA/Final EIS are intended to meet the purpose and need and address the issue, thereby providing a basis for eventual selection of an alternative in a decision (BLM NEPA handbook and Forest Service Handbook 1909.15 – National Environmental Policy Act Handbook Chapter 10 – Environmental Analysis). The Proposed LUPA/Final EIS considered cooperating agency input provided on the Draft LUPA/EIS within the stated purpose and need of this planning effort.

As stated in the LUPA/FEIS in **Section 1.1**, Introduction, the BLM and the Forest Service prepared the Nevada LUP amendment with an associated EIS to be applied to lands with GRSG habitat. This effort responds to the USFWS's March 2010 'warranted, but precluded' Endangered Species Act listing petition decision, which stated that existing regulatory mechanisms in BLM and the Forest Service land use plans was inadequate to protect the species and its habitat. The range of alternatives, including the preferred alternative and its components, focus on areas affected by threats to GRSG habitat identified by the USFWS in the March 2010 listing decision. Formulated by the planning team, the preferred alternative represents those goals, objectives, and actions determined to be most effective at resolving planning issues, balancing resource use at this stage of the process, and meets the stated purpose and need for action. While collaboration is critical in developing and evaluating alternatives, the selection of a preferred alternative remains the exclusive responsibility of the BLM and Forest Service. See **Section 2.7**, Considerations for Selecting a Preferred Alternative, in the Proposed LUPA/Final EIS for further details.

The BLM and Forest Service considered a reasonable range of alternatives during the GRSG planning process in full compliance with NEPA. CEQ regulations (40 CFR 1502.1) require that the BLM and Forest Service consider reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. While there are many possible alternatives or actions to manage public lands and GRSG in the planning area, the BLM and Forest Service fully considered the management opportunities presented in the planning issues and criteria developed during the scoping process to determine a reasonable range of alternatives. In addition, question 2a of the Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations states that an EIS is required to examine all reasonable alternatives rather than all alternatives (CEQ 40 Questions). As a result, six alternatives were analyzed in detail in the Draft LUPA/EIS that best addressed the issues and concerns identified by the affected public. The range of alternatives in the Draft LUPA/EIS represented a full spectrum of options that address the issues of GRSG protection, including a no action alternative (current management, Alternative A) up to a conservation of all occupied GRSG habitat within the Nevada and Northeastern California Sub-region (Alternative C). Additional alternatives suggested that fit within the range of alternatives are considered to have been adequately analyzed and were not addressed separately.

As described in **Section 1.4**, Planning Process, of the Draft LUPA/EIS, the Nevada and Northeastern California GRSG LUPA/EIS planning team employed the BLM and Forest Service planning process to develop a reasonable range of alternatives for the LUPA. The BLM and Forest Service complied with NEPA and the CEQ implementing regulations at 40 CFR 1500 in the development of alternatives for this Draft LUPA/EIS, including seeking public input and analyzing reasonable alternatives. The alternatives include management options for the planning area that would modify or amend decisions made in the BLM field and district office and forest district LUPs, as amended, to meet the planning criteria, to address issues and comments from cooperating agencies and the public, or to provide a reasonable range of alternatives. Since this is a plan amendment to address GRSG conservation, many decisions from the existing LUPs are acceptable and reasonable.

Public input received during the scoping process was considered to ensure that all issues and concerns would be addressed, as appropriate, in developing the alternatives. The planning team developed planning issues to be addressed in the LUPA, based on broad concerns or controversies related to conditions, trends, needs, and existing and potential uses of planning area lands and resources. Additionally, the five resulting action alternatives (Alternatives B, C, D, E, and F) in the Draft LUPA/EIS offered a range of possible management approaches for responding to planning issues and concerns identified through public scoping, and to maintain or increase GRSG abundance and distribution in the planning area. While the goal is the same across alternatives, each alternative contains a discrete set of objectives and management actions and constitutes a separate LUPA with the potential for different long-range outcomes and conditions. Each alternative was analyzed to determine the relative effects and impacts on GRSG as well on other lands uses, resource constraints, and socioeconomics.

The relative emphasis given to particular resources and resource uses differs as well, including allowable uses, restoration measures, and specific direction pertaining to individual resource programs. When resources or resource uses are mandated by law or are not tied to planning issues, there are typically few or no distinctions between alternatives. Meaningful differences among the six alternatives are described in **Section 2.8**, Comparison of Alternatives, in the Draft LUPA/EIS.

As part of the alternatives development process, only alternatives that are considered practical and feasible from a technical and economic standpoint were considered for analysis in the Draft LUPA/EIS (CEQ 40 Questions). Some alternatives were considered but eliminated from analysis for a variety of reasons. See **Section 2.6**, Alternatives Eliminated from Detailed Analysis in the Draft LUPA/EIS, for explanations of these alternatives and why they were eliminated from consideration.

Based on this alternative development process, the BLM and Forest Service considered input from cooperating agencies, environmental organizations, and the public. As described in **Section 2.4.2**, Alternative B in the Draft LUPA/EIS, the BLM and Forest Service used the GRSG conservation measures in A Report on National Greater Sage-Grouse Conservation Measures (NTT 2011) to form BLM and Forest Service management direction under Alternative B, which is consistent with the direction provided in BLM Washington Office Instruction Memorandum 2012-044 (the BLM and Forest Service must consider all applicable conservation measures developed by the NTT in at least one alternative in the land use planning process).

During scoping for the Nevada and Northeastern California GRSG Draft LUPA/EIS, individuals and conservation groups submitted management direction recommendations for protection and conservation of GRSG and its habitat, including the GRSG Recovery Alternative and proposed disturbance cap. The recommendations, in conjunction with resource allocation opportunities and internal sub-regional BLM and Forest Service input, were reviewed in order to develop BLM and Forest Service management direction for GRSG under Alternative C (Draft LUPA/EIS, **Section 2.4.3**, Alternative C).

Alternative D incorporates adjustments to the NTT report (NTT 2011) to provide a balanced level of protection, restoration, enhancement, and use of resources and services to meet ongoing programs and land uses, and was developed in full cooperation with the cooperating agencies, taking note of the agencies' concerns with socioeconomic issues.

Alternative E is based on the State of Nevada's Conservation Plan for GRSG in Nevada and would apply to all BLM-administered and National Forest System lands in Nevada. The State of California did not submit a proposal for a complete alternative and as such, Alternative E would only apply to BLM-administered and National Forest System lands in Nevada.

In **Section 2.6**, Alternatives Eliminated from Detailed Analysis, of the Draft LUPA/EIS, the Elko County Alternative was analyzed but not considered in detail in the Draft LUPA/EIS primarily because it is contained within the existing range of alternatives (see **Section 2.11.2**, Elko County Plan in the Proposed LUPA/Final EIS).

Whether the GRSG is determined for listing by the USFWS is outside the jurisdiction of the BLM and Forest Service and beyond the scope of this EIS. As noted in the purpose and need, the BLM and Forest Service are considering conservation measures intended to protect the species and its habitat. As such, the BLM and Forest Service did not develop alternatives based on the USFWS listing the species under the ESA (see **Section 1.5.4**, Issues Eliminated from Detailed Analysis Because They Are Beyond the Scope of the LUPAs (and Therefore Not Addressed in the LUPAs)).

The BLM and Forest Service is currently in full compliance with existing laws, rules, regulations, and policy, including BLM Manual 6840, Special Status Species Management, and rangeland health regulations, found at 43 CFR 4180.2. As discussed in the USFWS listing decision, these current existing regulatory mechanisms have not been sufficient to prevent GRSG habitat loss or population declines. See **Section 2.6**. Alternatives Eliminated from Detailed Analysis, for an explanation on why an alternative based on current BLM and Forest Service management was considered but excluded from detailed analysis.

Best Available Information Baseline Data

Summary

Issue 1: Commenters expressed concern about lack of site-specific data, especially from local sources, including ranchers. Commenters stated science and methodology relied upon by the agencies in completing the Draft LUPA/EIS is flawed and incomplete. The agencies' heavy reliance on the incomplete Ecological Site Descriptions (ESDs) and the inadequate disclosure that the relevant variables were incomplete falls well short of NEPA's requirements.

Issue 2: Commenters stated the No Action Alternative is incorrect. The agencies have artificially deflated the No Action Alternative.

Issue 3: Commenters stated the GRSG habitat maps are inaccurate. The BLM and Forest Service do not provide a quantitative definition of preliminary priority habitat. BLM and Forest Service's current definition of preliminary priority habitat is not only vague and inconsistent but also overly broad. GRSG habitat maps should be amended in the RMPs based on site-specific data.

Issue 4: Commenters stated the Draft LUPA/EIS does not properly address the benefits of livestock grazing in relation to GRSG habitat conservation.

Issue 5: Commenters also requested that the BLM and Forest Service provide a clearer definition of "valid existing rights."

Response

Response 1: The CEQ regulations require an environmental impact statement to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The description shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues" (40 CFR 1502.15). Additionally, this EIS is a programmatic NEPA effort to conserve GRSG and its habitat across a broad geographic area. As such, the BLM and the Forest Service described the current conditions and trends in the affected environment broadly, across a range of conditions, appropriate to program-level land use planning actions.

The BLM and the Forest Service complied with these regulations in describing the affected environment. The requisite level of information necessary to make a reasoned choice among the alternatives in an EIS is based on the scope and nature of the proposed action. The analysis provided in **Chapter 3**, Affected Environment, and various appendices in the Proposed LUPA/Final EIS is sufficient to support, at the general land use planning-level of analysis, the environmental impact analysis resulting from management actions presented in the Proposed LUPA/Final EIS.

As specific actions come under consideration, the BLM and the Forest Service will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. Site-specific concerns and more detailed environmental descriptions will be addressed when project-level reviews are tiered to the analysis in this EIS (40 CFR 1502.20, 40 CFR 1508.28). In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for any site-specific actions.

Response 2: The agencies did not artificially deflate the information for the no action alternative. The information is taken directly from the existing land use plans. All alternatives are subject to existing laws, even the no action alternative (see **Section 1.4** Planning Process; **Section 1.5.1**, Development of Planning Criteria; and **Section 1.6**, Relationship to Other Policies and Plans in the

Proposed LUPA/Final EIS). The no action alternative is fully analyzed in the Proposed LUPA/Final EIS; however, the purpose and need for this effort responds to the USFWS's 2010 finding that existing regulatory mechanisms in existing land use plans are inadequate to protect the species; therefore, the no action is not sufficient to meet this purpose and need.

Response 3: The BLM and Forest Service National Greater Sage-Grouse Planning Strategy is a framework for identifying two categories of GRSG habitat: priority habitat and general habitat.

Figure 1-2 in the Proposed LUPA/Final EIS identifies GRSG habitat areas in Nevada. This map is a planning support tool that incorporates the best available data (lek observations, telemetry locations, survey and inventory reports, vegetation cover, soils information, and aerial photography) into a statewide preliminary spatial view of GRSG habitat. This tool provides resource managers with broad-scale information to guide conservation and land use planning efforts in the context of GRSG management at the landscape scale (1:100,000).

GRSG habitat mapping used in the Draft LUPA/EIS was derived from the Nevada Department of Wildlife (NDOW) GRSG Habitat Categorization data. The data were spatially intersected with Nevada Land Status data, and lands managed by BLM and Forest Service were extracted from the results. The NDOW Category 1 – Essential/Irreplaceable Habitat and Category 2 – Important Habitat were combined to create the PPH areas (bright pink). The NDOW Category 3 – Moderate Importance Habitat, is shown as the PGH areas (blue). The NDOW Category 4 – Transitional Range, Category 5 – Unsuitable Habitat, and non-habitat areas are not shown. The habitat categorization analysis was performed only for areas within the GRSG population management units (PMUs) identified by the Governor's GRSG Conservation Team (2002).

This map provided information for the BLM and Forest Service GRSG planning process and was used in the development of the Draft LUPA/EIS alternatives. This map was a starting point in the process, and the boundaries of the areas are expected to change. Additional details are provided in **Section 3.2** of the Proposed LUPA/Final EIS as well as the NDOW White Paper on BLM and US Forest Service Preliminary Habitat Map, available on the BLM Nevada web site.

For the Northeast California/Northwest Nevada GRSG population, California BLM used a mapping methodology based on the Doherty modeling (Doherty et al. 2011), including the 100 percent breeding bird density core regions, or all known active leks with appropriate buffering (6.4 kilometers [4 miles] for 25 percent and 50 percent kernels, 8.5 kilometers [5.3 miles] for 75 percent and 100 percent kernels). Areas were modified by local knowledge of seasonal range use, known connectivity, and vegetative and natural barriers. In California, extensive radio telemetry information was available, providing a direct footprint of GRSG use areas. All mapped habitat within California and California-managed lands in northwestern Nevada are included as PHMA and GHMA.

Information regarding the revised habitat mapping used for the Proposed LUPA/Final EIS, including total acres of each habitat type, is included in **Sections 1.1.2** and **2.4.3** and **Appendix A** of the Proposed LUPA/Final EIS.

Response 4: Both the BLM's and Forest Service's planning processes allow for analysis and consideration of a range of alternatives in the Draft LUPA/EIS that identify and incorporate conservation measures to conserve, enhance, and restore GRSG habitat and to eliminate, reduce, or minimize threats to this habitat to ensure that a balanced management approach was recommended. The Draft LUPA/EIS includes alternatives that provide a greater and lesser degree of restrictions in various use programs, but would not eliminate or invalidate any valid existing development rights. For example, livestock grazing levels vary by alternative.

Response 5: Valid existing rights refer to authorized resource uses that will not be affected by this planning effort and are defined in the glossary in **Chapter 8**.

GIS Data and Analysis

Summary

Issue 1: Commenters requested project-level maps and project-level mitigation.

Issue 2: Commenters questioned the delineation of the planning area boundary, in particular for Esmeralda County.

Response

Response 1: The decisions under consideration by the BLM and the Forest Service are programmatic in nature. In accordance with applicable law and policy, as the decisions in this RMP are implemented, the BLM will review the location and scope of project-level proposals and the extent to which they would include GRSG habitat. The scope of the analysis was conducted at a regional, programmatic level; the decisions in the plan are at a land use planning level, therefore project-level information is out of scope for this planning effort.

Response 2: The planning area is the geographic area within which the BLM and Forest Service will make decisions during a planning effort and includes the BLM Tonopah Field Office, which overlaps with Esmeralda County. A planning area boundary includes all lands regardless of jurisdiction; however, the BLM and Forest Service will only make decisions on lands that fall under the BLM's and Forest Service's jurisdiction (including subsurface minerals).

Unless the State Director determines otherwise, the planning area for a LUPA is the geographic area associated with a particular field office (43 CFR 1610.1(b)). State Directors may also establish regional planning areas that encompass several field offices and/or states, as necessary. For this environmental impact statement, decision areas are those public lands and mineral estates within the planning area that are encompassed by all designated habitat (which includes priority habitat, general habitat, and other habitat).

Indirect Impacts

Summary

Issue 1: Commenters requested project-level impacts, especially regarding mitigation costs.

Issue 2: Commenters stated the No Action Alternative is incorrect. The agencies have artificially deflated the No Action Alternative.

Issue 3: Commenters questioned why current regulatory mechanisms are inadequate.

Response

Response 1: As the decisions under consideration by the BLM and the Forest Service are programmatic in nature and would not result in the authorization of site-specific activities on public lands (e.g., the BLM is not approving an Application for Permit to Drill to start drilling), the scope of the analysis was conducted at a regional, programmatic level. The analysis focuses on the direct, indirect, and cumulative impacts that could potentially result from on-the-ground changes. This analysis identifies impacts that may result in some level of change to the resources, regardless of whether that change is beneficial or adverse. The analysis identified that mitigation costs would be higher from undertaking anthropogenic disturbance activities within PHMA and GHMA. The agencies' mitigation strategies allow for one year to complete a more specific mitigation plan. The actual costs will be determined at the site-specific level during implementation.

Response 2: As stated in the Draft LUPA/EIS, the BLM and the Forest Service are preparing LUP amendments with associated EISs for LUPs applied to lands with GRSG habitat. This effort responds to the USFWS's March 2010 'warranted, but precluded' Endangered Species Act listing petition decision, which stated that existing regulatory mechanisms in BLM and the Forest Service land use plans were inadequate to protect the species and its habitat; GRSG populations are currently declining, showing that current regulatory mechanism are inadequate.

The plan amendments will focus on areas affected by threats to GRSG habitat identified by the USFWS in the March 2010 listing decision. The two primary threats to sagebrush habitat are infrastructure from energy development in the eastern portion of the species' range and conversion of sagebrush habitat to annual grasslands due to wildfires in the western portion of the species' range. To address the threats, BLM and Forest Service are considering a range of changes in management of GRSG habitats to avoid the continued decline of populations and habitats across BLM-administered and National Forest System lands. This purpose and need provides the appropriate scope to allow the BLM and the Forest Service to analyze a reasonable number of alternatives to cover the full spectrum of potential impacts.

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Cumulative Impact Analysis

Summary

The Draft LUPA/EIS does not adequately analyze cumulative effects from past, present, and reasonably foreseeable future actions.

Response

The BLM and the Forest Service thoroughly explained its consideration and analysis of cumulative effects in the Draft LUPA/EIS in **Chapter 5**, Cumulative Impacts. The Draft LUPA/EIS considered the present effects of past actions, to the extent that they are relevant, and present and reasonably foreseeable (not highly speculative) federal and non-federal actions, taking into account the relationship between the proposed alternatives and these reasonably foreseeable actions. This discussion summarizes CEQ guidance from June 24, 2005, stating that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The BLM and the Forest Service explicitly described their assumptions regarding proposed projects and other reasonably foreseeable future actions. On National Forest System lands, reasonably foreseeable actions are those that would occur under their current land use plans from a broad-scale perspective.

The BLM and the Forest Service have complied fully with the requirements of 40 CFR 1508.7 and prepared a cumulative impact analysis based on the broad nature and scope of the proposed management options under consideration at the land use planning level.

The Draft LUPA/EIS contains a qualitative discussion of cumulative effects at the WAFWA Management Zone scale, which set the stage for a more quantitative analysis to be contained in the Proposed LUPA/Final EIS. As part of the cumulative effects analysis process completed for each WAFWA management zone, additional quantitative cumulative analysis was added to the Proposed LUPA/EIS in **Chapter 5,** Cumulative Impacts.

Mitigation Measures

Summary

1. The BLM and Forest Service need to include a monitoring, mitigation, and adaptive management plan/framework in the Proposed LUPA/Final EIS that will include specific criteria for determining GRSG conservation success and how the disturbance percentages will be calculated.
2. The BLM and Forest Service need to define when mitigation would be used and have enough specificity in the mitigation and monitoring plans to implement them in development actions.

Response

Mitigation and monitoring frameworks were introduced in the Draft LUPA/EIS in **Chapter 2** and in **Appendices D** and **E**. An Adaptive Management strategy was also introduced in **Chapter 2** of the Draft LUPA/EIS. A more detailed mitigation strategy, monitoring framework, and adaptive management strategy have been incorporated into the Proposed Plan in **Chapter 2** of the Proposed LUPA/Final EIS and in **Appendices I**, **E**, and **J**, respectively.

Mitigation will be applied to all implementation actions/decisions that take place on federal lands within GRSG habitat during the life of this plan. As described in the Proposed LUPA/Final EIS, all permitted/authorized disturbance activities would result in a net conservation gain, subject to valid existing rights (see **Appendix F**). Mitigation has been further defined as Regional Mitigation and is described in **Section 2.7.3** in the Proposed LUPA/Final EIS. The Regional Mitigation Framework was developed to follow the BLM's Regional Mitigation Manual MS-1794, Forest Service Handbook FSH 1909.15, and CEQ 40 CFR 1508.20.

The Mitigation Framework, through the mitigation hierarchy, guides the BLM and Forest Service. The hierarchy direction is to 1) avoid impacts entirely by not taking a certain action or parts of an action, 2) if unable to avoid, minimize impacts by limiting the degree or magnitude of an action or parts of an action, and 3) if avoidance or minimizing is not possible, compensate impacts associated with future implementation actions. If residual impacts on GRSG from implementation-level actions remain after applying avoidance or minimization measures, then compensatory mitigation projects will be used to offset the residual impacts in an effort to achieve the land use plan goals and objectives. As articulated in **Appendix I** in the Proposed LUPA/Final EIS, compensatory mitigation will occur on sites that have the potential to yield the greatest conservation benefit to the GRSG, regardless of land ownership. These sites should be sufficiently "durable." According to BLM Manual Section 1794, durability is defined as "the administrative, legal, and financial assurances that secure and protect the conservation status of a compensatory mitigation site, and the ecological benefits of a compensatory mitigation project, for at least as long as the associated impacts persist."

Specific mitigation strategies, based on the framework, will be developed by regional teams (at the WAFWA Management Zone level) within one year of the issuance of the Record of Decision. These strategies will guide the application of the mitigation hierarchy to address GRSG impacts within that WAFWA Management Zone. The WAFWA Management Zone Regional Mitigation Strategy will be applicable to BLM and Forest Service lands within the zone's boundaries. Subsequently, the BLM and Forest Service NEPA analyses for implementation-level decisions that might impact GRSG will include analysis of mitigation recommendations from the relevant WAFWA Management Zone Regional Mitigation Strategy(ies).

The Monitoring Framework in **Appendix E** in the Proposed LUPA/Final EIS outlines the methods that the BLM and Forest Service will use to monitor and evaluate the implementation and effectiveness of the planning strategy and the land use plans to conserve the species and its habitat. The regulations for the BLM (43 CFR 1610.4-9) and the Forest Service (36 CFR 219.12) require that land use plans establish intervals and standards, as appropriate, for monitoring and evaluations, based on the sensitivity of the resource to the decisions involved.

Implementation monitoring results will provide information to allow the BLM and Forest Service to evaluate the extent that the decisions from the agencies' LUPs to conserve GRSG and their habitat have been implemented. Effectiveness monitoring will provide the information to evaluate whether BLM and Forest Service actions achieve the objective of the planning strategy (BLM IM 2012-044) and the conservation measures contained in the land use plans to conserve GRSG populations and their habitats.

Monitoring efforts will include data for measurable quantitative indicators of sagebrush availability, anthropogenic disturbance levels, and sagebrush conditions. This information will assist the BLM and the Forest Service with identifying whether or not they are achieving their land use plan goals and objectives, reaching an adaptive management soft or hard trigger, as well as providing information relative to the disturbance cap. Specifically, habitat degradation (percent of human activity in a biologically significant unit), habitat availability (percent of sagebrush in a biologically significant unit), and habitat degradation intensity (density of energy facilities and mining locations) will be gathered to inform the disturbance cap objective. See the Proposed Plan GRSG Screening Criteria (Actions SSS 1 through SSS 3).

The BLM and Forest Service will use the data collected from monitoring (**Appendix E** in the Proposed LUPA/Final EIS) to identify any changes in habitat conditions related to the goals and objectives of the plan. The agencies will use the information collected through monitoring to determine when adaptive management triggers are met.

Adaptive management is a systematic approach for improving resource management by learning from management outcomes. An adaptive approach involves exploring alternative ways to meet management objectives, anticipating the likely outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions accordingly.

Incorporating adaptive management into the Proposed LUPA/Final EIS will ensure a degree of certainty that the decisions in the plan will effectively contribute to the elimination or adequate reduction of one or more threats to the greater GRSG and its habitat. The adaptive management approach incorporates a set of triggers in the plan, a soft and hard trigger. In collaboration with the BLM, USFWS, Forest Service, USGS, and states of Nevada and California, these triggers were developed to inform the BLM and Forest Service as to when the federal agency needs to respond (take action) to address a declining trend in GRSG or GRSG habitat figures.

Soft triggers represent an intermediate threshold indicating that management changes are needed at the project/implementation level to address habitat and population losses. Hard triggers represent a threshold indicating that immediate action is necessary to stop a severe deviation from GRSG conservation goals and objectives as set forth in the BLM and Forest Service plans. The adaptive management soft and hard triggers and land use planning responses to these triggers are described and analyzed fully in this Proposed LUPA/Final EIS (see **Section 2.7**, Adaptive Management).

C.2.2 FLPMA

Summary

Alternatives in the Draft LUPA/EIS, particularly Alternatives C and F, failed to comply with the multiple-use mandates found in the BLM's FLPMA and the Forest Service's Multiple-Use Sustained-Yield Act because they are overly focused on protecting GRSG and GRSG habitat.

Response

The BLM's FLPMA (Section 103(c)) defines "multiple use" as the management of the public lands and their various resource values so that they are used in the combination that will best meet the present and future needs of the American people. Accordingly, the BLM and Forest Service are responsible for the complicated task of striking a balance among the many competing uses to which public lands can be put. The BLM's multiple-use mandate does not require that all uses be allowed on all areas of the public lands. The purpose of the mandate is to require the BLM to evaluate and choose an appropriate balance of resource uses, which involves tradeoffs between competing uses. The FLPMA also directs the BLM to develop and periodically revise or amend its RMPs, which guide management of BLM-administered lands, and provides an arena for making decisions regarding how public lands would be managed and used.

Consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 USC 528–531), the Forest Service manages National Forest System land to sustain the multiple use of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land. Resources are managed through a combination of approaches and concepts for the benefit of human communities and natural resources. Land management plans guide sustainable, integrated resource management of the resources within the plan area in the context of the broader landscape, giving due consideration to the relative values of the various resources in particular areas. The Forest Service is required by statute to have a national planning rule. The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976, requires the Secretary of Agriculture to issue regulations under the principles of the Multiple-Use Sustained-Yield Act of 1960 for the development and revision of land management plans.

The Proposed LUPA/Final EIS is a targeted amendment specifically addressing goals, objectives, and conservation measures to conserve GRSG and to respond to the potential of its being listed (see **Section 1.3**, Purpose and Need). Both the Forest Service's and BLM's planning processes allow for analysis and consideration of a range of alternatives in the Draft LUPA/EIS that identified and incorporated conservation measures to conserve, enhance, and restore GRSG habitat and to eliminate, reduce, or minimize threats to this habitat to ensure that a balanced management approach was recommended. The Draft LUPA/EIS and Proposed LUPA/Final EIS include alternatives that provide a greater and lesser degree of restrictions in various use programs but would not eliminate or invalidate any valid existing development rights.

Additionally, the BLM and the Forest Service developed the Nevada and Northeastern California Draft LUPA/EIS with involvement from cooperating agencies (see **Section 6.3**, Cooperating Agencies/Entities including NDOW, CDFW, the SETT, other federal agencies, and other state, local and tribal agencies/governments) to ensure that a balanced multiple-use management strategy to address the protection of GRSG while allowing for utilization of renewable and nonrenewable resources on the public lands is developed.

Consistency with Other state, County, or Local Plans

Summary

The Draft LUPA/EIS process did not comply with the BLM's requirements to be consistent with other federal, state, local, and tribal plans and policies. Commenters specifically noted that BLM's goals, objectives, and management actions are inconsistent with the Nevada Rangeland Monitoring Handbook (NCE 2006), Pershing County, Nevada Land Use Planning, specifically the Pershing County Natural Resources Land Use Plan (County Plan) and the Pershing County Master Plan, the State of Nevada's Sagebrush Ecosystem Program, the 2011 Nye County Comprehensive Master Plan and the Elko County GRSG Plan, Lincoln County's policy of "no net loss" of AUMs within the County, the Lincoln County Lands Acts, the Ely Resource Management Plan (the prohibition on disposals within PHMAs and GHMAs is in conflict with both), Lander County's GRSG strategy, and the Eureka County Master Plan and other plans, policies, and controls.

Additionally, the BLM and Forest Service failed to note in the Draft LUPA/EIS what if any effort has been completed to resolve inconsistencies between the LUPA and state, local, and tribal plans.

Response

The BLM's land use plans must be consistent with officially approved or adopted resource-related plans of Indian tribes, other federal agencies, and state and local governments to the extent that such plans and policies are consistent with federal law and the purposes, polices, and programs of federal law (see 43 CFR 1610). The BLM and Forest Service have worked closely with state and local governments during preparation of the Draft LUPA/EIS. The Draft LUPA/EIS lists the cooperating agencies actively involved in the planning process in **Section 6.3**, Cooperating Agencies/Entities. As described in **Chapter 6**, Consultation and Coordination, the BLM and Forest Service coordinated with the state, county, and tribal government cooperating agencies to review the range of alternatives associated with the Draft LUPA/EIS and identify potential inconsistencies between the alternatives and each agency's applicable plans. This allows the state, local, and tribal cooperating agencies to use their special expertise regarding the familiarity with their own state, local, or tribal plans. On the local level, it is a county's responsibility to accurately identify and communicate any inconsistencies between that county's plan and the proposed alternative.

The BLM and Forest Service work to find a balance among uses and needs as reflected in these local government plans and have done so in the preparation of the Draft LUPA/EIS; a list of these plans can be found in the Proposed LUPA/Final EIS in **Section 1.6**, Relationship to Other Policies, Plans, and Programs. The BLM and Forest Service are aware that there are specific state or local laws relevant to aspects of public land management that are discrete from, and independent of, federal law. However, BLM and Forest Service are bound by federal law. As a consequence, there may be inconsistencies that cannot be reconciled. The FLPMA requires that BLM's land use plans be consistent with state and local plans "to the extent practical." In a situation where state and local plans conflict with federal law, there will be an inconsistency that cannot be resolved. Thus, while state, county, and federal planning processes, under FLPMA, are required to be as integrated and consistent as practical, the federal agency planning process is not bound by or subject to county plans, planning processes, or planning stipulations.

While the BLM is not obligated to seek consistency, the agency is required to describe the inconsistencies between the proposed action and the other plans, policies, and/or controls within the EIS, so that the state and local governments have a complete understanding of the impacts of the Proposed LUPA on state and local management options. This information has been updated in the Proposed LUPA/Final EIS in **Section 1.6**.

The BLM and Forest Service coordinates with cooperating agencies commensurate with each agency's recognized jurisdiction or expertise. In areas where the States of California and Nevada have clear jurisdiction, such as wildlife populations, the BLM and Forest Service have worked closely with that state agency. In cases where a county or agency has expertise, such as local county socioeconomic information, the BLM and Forest Service have worked closely with the group to incorporate the information into the EIS.

In the process of developing the Proposed LUPA/Final EIS, the BLM and Forest Service solicited input from the cooperating agencies regarding consistency of the administrative draft Proposed Plan with applicable local, state, tribal, and other planning documents.

Chapter 6 of the Proposed LUPA/Final EIS identifies the inconsistencies between the Proposed Plan and the state, county, and tribal plans.

C.2.3 Other Laws

Summary

The Draft LUPA/EIS does not clearly describe how proposed management actions would comply with other laws, including the General Mining Law, the Taylor Grazing Act, the Public Rangeland Improvement Act, the Energy Policy Act of 2005 and Energy Policy and Conservation Act of 2000, other multiple use mandates (e.g., Multiple-Use Sustained Yield Act of 1960, Forest and Rangeland Renewable Resources Planning Act of 1974, National Forest Management Act of 1976), other federal agency regulations (e.g., Federal Regulatory Energy Commission), and state laws (e.g., Nevada Water Laws).

Response

The Management Common to All Alternatives sections in the Draft and Proposed LUPA/Final EIS documents state that all alternatives would comply with state and federal laws, regulations, policies, and standards, and implement actions originating from laws, regulations, and policies. Additionally, in **Section 1.5.1**, Development of Planning Criteria, the BLM and Forest Service has a criterion stating that all BLM and Forest Service alternatives would comply with existing laws, regulations, and policies. The BLM and Forest Service have reviewed all actions in the Proposed LUPA/Final EIS for compliance with required laws, regulations, and policies.

C.2.4 Greater Sage-Grouse

NTT Report/Findings

Summary

Commenters contended that findings contained in the NTT report are based on science that is flawed, arbitrary, outdated, and narrowly focused. Commenters also assert that the NTT report contains technical errors, does not comply with existing laws, and has not undergone adequate peer review.

Response

A National Technical Team (NTT) was formed as an independent, science-based team to ensure that the best information about how to manage GRSG habitat is reviewed, evaluated, and provided to the BLM and the Forest Service in the planning process. The group produced a report in December 2011 that identified science-based conservation measures to promote sustainable GRSG populations. The report was used as the basis for at least one alternative, which is consistent with the direction provided in BLM Washington Office Instruction Memorandum 2012-044. The NTT report cited 122 references, including papers published in formal scientific literature such as *Journal of Wildlife Management, Conservation Biology*, *Biological Conservation*, *Wildlife Biology*, *BioScience* and others, as well as graduate theses and dissertations, conservation strategies, the USFWS 2010 finding, and others representing the best available science.

Conservation Objectives Team (COT) Report

Summary

Commenters had two distinct views regarding the COT report. One group considered the report overly biased and not representative of the best available information. The other group suggested the Draft LUPA/EIS was not fully consistent with and did not completely meet the COT report conservation objectives and therefore requires additional management actions or clarification to address those deficiencies.

Response

In March 2012, the USFWS initiated a collaborative approach to develop range-wide conservation objectives for GRSG to inform the 2015 decision about the need to list the species and to inform the collective conservation efforts of the many partners working to conserve the species. In March 2013, this team released the Conservation Objectives Team (COT) report based upon the best scientific and commercial data available at the time that identifies key areas for GRSG conservation, key threats in those areas, and the extent to which threats need to be reduced for the species to be conserved. The report serves as guidance to federal and state agencies and others in focusing efforts to achieve effective conservation for this species.

Throughout the development of the Proposed LUPA/Final EIS, the BLM and Forest Service worked with the USFWS and state agencies to develop a proposed plan that fully addresses each of the threats identified in the COT report to the extent possible. Effects on GRSG from each of the identified threats are analyzed in **Section 4.4** of the Proposed LUPA/EIS.

Policy Guidance

Summary

Commenters expressed concern about the lack of consideration of BLM Manual 6840 in the Draft LUPA/EIS, particularly in the alternatives. In addition, commenters questioned the formation of alternatives based on the NTT report and why the NTT report was included, especially since the IM has expired and has not been reissued.

Response

While the Proposed LUPA/Final EIS does not mention BLM Manual 6840 specifically, **Section 1.5**, Development of Planning Criteria, in the Proposed LUPA/Final EIS states that "the approved LUPA will comply with BLM direction…and all other applicable BLM policies and guidance," which would include BLM Manual 6840. The analysis responds to the objectives of BLM Manual 6840, which are to: 1) preserve the ecosystem upon which species depend, and 2) initiate proactive conservation measures that minimize listing of the species under the ESA.

For further details related to how and why the NTT was used in alternative development, see the response in **Section 7.1**, NTT Report above.

BLM is implementing IM 2012-044 through the GRSG planning effort. When an IM expires without being superseded, it can still be applicable and provide guidance to the BLM. The fact that IM 2012-044 expired does not mean the BLM has no authority to continue to analyze the conservation measures identified in the NTT Report. The BLM is appropriately considering and evaluating the measures in the NTT Report, in addition to any other relevant science, through the GRSG planning process.

Range of Alternatives

Summary

Commenters pointed out inconsistencies and suggested clarifications to the alternatives related to GRSG, including:

- Clarifying the definition of no unmitigated loss
- How maps would be revised over time
- Whether site-specific assessments would be conducted at the project level
- Adding more description to the No Action Alternative

- Framing the analysis according to threats rather than BLM and Forest Service programs

Commenters also questioned the accuracy and application of the maps and habitat mapping criteria. Commenters did not feel that management actions provided regulatory certainty.

Response

As noted above, **Section 2.4.1** of the Proposed LUPA/Final EIS describes how the Nevada and Northeastern California GRSG LUPA/EIS planning team employed the BLM and Forest Service planning process to develop a reasonable range of alternatives for the Draft LUPA/EIS and Proposed LUPA/Final EIS and worked closely with the State with assistance from the USFWS.

Meaningful differences among the seven alternatives are described in **Table 2-13**, Comparative Allocations Summary by Alternative by Acres Allotted, and in **Section 2.10**, Detailed Description of Alternatives, of the Proposed LUPA/Final EIS.

The following have been included in the Proposed LUPA/Final EIS to provide specificity/clarity: goals, objectives, management actions, and RDFs (consistent with applicable law) to address predator control and predation on GRSG (**Chapter 1** and **2**), noise and seasonal restrictions for both construction and long-term implementation of land use activities (**Chapters 2** and **3** and **Appendix K**), additional management actions for fences (**Chapter 2**), no net unmitigated loss (**Chapter 2** and **Alternative I**), lek buffers were revised based on a review of the best available science (**Chapter 3**, Biology and Life History), and the 3 percent disturbance cap has been further explained in the Proposed LUPA/Final EIS (**Appendix F**). **Section 1.5.1**, Development of Planning Criteria, in the Proposed LUPA/Final EIS provides general guidance for special status species, but it does not provide language relative to specific conservation actions for specific species. Monitoring and mapping has also been clarified in the Proposed LUPA/Final EIS (**Appendix E**), and a description of the habitat mapping process for each alternative is presented in **Section 2.10**, Detailed Description of Alternatives.

The Proposed Plan contains a mechanism that allows for evaluation of circumstances on case-by-case basis at the site-specific scale that would be addressed via subsequent project-level NEPA analysis. Site-specific projects are not identified in the broad-scale plan, but there are several restoration actions included in the Draft LUPA/EIS and in the GRSG, Vegetation, and Wildfire management actions in the Proposed Plan. Language has been added to **Chapter 1** of the Proposed LUPA/Final EIS to clarify that impacts from military overflight are outside the scope of the Proposed LUPA/Final EIS. **Chapter 4** of the Proposed LUPA/Final EIS includes analysis of noise-related impacts on GRSG from ground-based operations.

Table 2-1 displays a crosswalk between USFWS/COT identified threats to GRSG within the BLM's and Forest Service's resource program areas. The GRSG analysis in **Chapter 4** (**Section 4.1**) also contains a crosswalk table of resource programs impacting GRSG by threat. The BLM and Forest Service manage their lands by resource program area. The crosswalk tables assist the public in determining where the analysis of each threat is covered under each by program area.

The protocol for developing maps and calculations based on GRSG habitat in the Proposed LUPA/Final EIS is identified in **Appendix A**.

Allocations identified under the alternatives were based on GIS calculations in the decision area and provide the certainty of application in a designated area. Some threats (such as Fires and Invasives) apply approaches for dealing with threats during the implementation phase.

Best Available Information Baseline Data

Summary

Commenters suggested new or additional literature for the BLM and Forest Service to consider and suggested re-interpretations of some of the literature cited in the Draft LUPA/EIS. Topics commenters were concerned about included:

- Adaptive Management
- Predation and perch discouragers
- GRSG habitat requirements
- Noise
- Use of Rangeland Health Assessments
- Disease
- Hunting
- Monitoring protocol
- How population size is measured
- Impacts from mineral development and grazing

Commenters were also concerned about GRSG habitat mapping, including how and when the habitat map would be updated and whether it would be done on a site-specific basis; the use of the updated maps in the Nevada Conservation

Plan; and the accuracy of the maps. Commenters also cautioned the BLM and Forest Service against using the maps for site-specific purposes.

Response

A description of the habitat mapping process is presented in **Appendix A** and the Adaptive Management section of the Proposed LUPA/Final EIS in **Chapter 2**.

The BLM and the Forest Service considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. The data needed to support broad-scale analysis of the planning area are substantially different than the data needed to support site-specific analysis of projects. The Draft LUPA/EIS data and information were presented in map and table form and were sufficient to support the broad-scale analyses required for land use planning. The analysis in the Proposed LUPA/Final EIS is thus supported.

Of the suggested studies and references put forth by the commenters, the BLM reviewed them to determine if they: 1) presented new information that would need to be incorporated into the Proposed LUPA/Final EIS; 2) were references already included in the Draft LUPA/EIS; or 3) provided the same information as already used or described in the Draft LUPA/EIS. The BLM determined that several of these references contained new or relevant information (e.g., regarding noise impacts, predation, and GRSG habitat characteristics), and subsequently clarified the analysis and updated the references cited in **Chapter 7** of the Proposed LUPA/Final EIS. In some cases, the additional literature was essentially the same as the sources used in the Draft LUPA/EIS or did not provide additional relevant information and was therefore not incorporated in the Proposed LUPA/Final EIS. The new information incorporated into the Proposed LUPA/Final EIS does not present a significantly different picture of the impacts, and the information submitted/used in the Proposed LUPA/Final EIS would not result in impacts that were not previously considered and analyzed within the spectrum of the alternatives in the Draft LUPA/EIS.

Impact Analysis

Summary

Commenters identified the negative impacts on GRSG from resource use management, including livestock grazing, wild horses and burros, and hunting. Commenters also submitted suggestions for improving or strengthening the impact analysis for GRSG in several areas, including:

- Improving the summary of the effects of conservation measures

- Increasing the geographic area of the effects analysis
- Describing the impacts from conversion of private lands
- Describing the impacts from fire, roads, noise, and fences
- Analyzing the effects of minerals and the relation to disturbance caps/no unmitigated loss
- The relevance of lek buffers
- Providing a more detailed analysis of Alternative A

Response

The Proposed LUPA/Final EIS provides an updated and expanded discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives. The Draft LUPA/EIS discussed the linkage of public and private lands and the potential for increased disturbance on private lands. Additionally, GRSG mapping for Alternative D gave "checkerboard" GRSG habitats a lower priority designation (i.e., general habitat or non-habitat), where appropriate. Examples of updated discussion can also be found in the following sections of the Proposed LUPA/Final EIS: **Sections 4.4.2**, **4.13.5** through **4.13.10**, **4.14.5** through **4.14.10**, **4.15.1**, and throughout **Chapter 5**. As required by 40 CFR 1502.16, the Draft LUPA/EIS provided a discussion of the environmental impacts of the alternatives, including the proposed action, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented. The Draft LUPA/EIS provided sufficiently detailed information to aid in determining whether to proceed with the preferred alternative or make a reasoned choice among the other alternatives in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1.

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29; Forest Service Handbook 1909.12 – Land Management Planning). The Draft LUPA/EIS and Proposed LUPA/Final EIS contain only planning actions and do not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM and the Forest Service will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known.

The Draft EIS used the most recent science, which shows burning and/or manipulation of sagebrush is not beneficial in occupied GRSG habitats and that retention and restoration of existing GRSG habitats should be the highest priority (see Baker 2011 and Connelly et al. 2011). The Proposed LUPA/Final EIS was subsequently updated with the most recent science available. The new information does not present a significantly different picture of the impacts, and the information submitted/used in the Proposed LUPA/Final EIS would not result in impacts that were not previously considered and analyzed within the spectrum of the alternatives in the Draft LUPA/EIS.

Cumulative Impact Analysis

Summary

The cumulative effects analysis is deficient, as it should include areas beyond the Nevada and northeastern California decision area and the analysis was deficient for hunting, predation, and West Nile virus. Positive impacts on GRSG should be included, as well as the GRSG conservation measures implemented on the Modoc National Forest.

Response

As described above, the BLM and Forest Service analyzed cumulative effects in the Draft LUPA/EIS. The BLM and Forest Service expanded and quantified cumulative impacts for the Proposed LUPA/Final EIS. **Chapter 5** in the Draft LUPA/EIS and Proposed LUPA/Final EIS considers the impacts on the environment that results from the incremental impacts of the Proposed LUPA/Final EIS when added to other past, present, and reasonably foreseeable future actions (federal or non-federal). This discussion summarizes CEQ guidance from June 24, 2005, stating that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The BLM and the Forest Service explicitly described their assumptions regarding proposed projects and other reasonably foreseeable future actions. On National Forest System lands, reasonably foreseeable actions are those that would occur under their current land use plans from a broad-scale perspective. The BLM and Forest Service have complied fully with the requirements of 40 CFR 1508.7 and prepared a cumulative impact analysis based on the broad nature and scope of the proposed management options under consideration at the land use planning level.

The BLM and Forest Service understand the potential threat to GRSG from the West Nile virus and have made reference to it in **Chapter 4** of the Draft LUPA/EIS and Proposed LUPA/Final EIS under the impact analysis for GRSG and GRSG Habitat (see **Sections 4.4.2** and **4.4.10** in the Proposed LUPA/Final EIS). Additionally, development of artificial ponds can increase the likelihood of the creation of pools of standing water, which can serve as mosquito breeding habitat, increasing the ability for West Nile virus to spread into landscapes otherwise not at risk to the pathogen (Walker and Naugle 2011). To prevent the spread of the West Nile virus, the Draft LUPA/EIS specifically addressed the design of artificial water impoundments to prevent mosquito breeding habitat. **Appendix D**, Required Design Features, of the Proposed LUPA/Final EIS addresses this threat.

The Forest Service identified 21 National Forests that would be included in the sub-regional EIS efforts. The Modoc National Forest was not included in this list for the following reasons. Although the Modoc National Forest was historically important to GRSG, there are currently no active strutting grounds (leks) on the Modoc National Forest. Much of the GRSG habitat on the Modoc National Forest has been lost to western juniper encroachment, and only one strutting ground remains for the population that is located off of forest lands. In addition, the Modoc National Forest contributed only a small amount of GRSG habitat to the 75 percent Breeding Bird Density data layer (Doherty et al. 2010). Hence, it was decided not to include the Modoc National Forest in the Nevada and Northeastern California Sub-regional EIS planning area. The Modoc National Forest is planning on revising its LUP, which will consider management and restoration guidance for GRSG. In addition, the Forest Service is involved in conservation efforts focused on restoring habitats for GRSG on federal lands in this area, which also includes the Modoc National Forest.

Additional information on hunting of GRSG within the Nevada and Northeastern California Sub-region has been added to **Chapter 1**, **Section 1.5.2** of the Proposed LUPA/Final EIS. Actions in the Proposed Plan were developed that contained elements of the predation actions identified in the State of Nevada's Greater Sage Grouse Conservation Plan (State of Nevada 2014).

Mitigation Measures

Summary

Commenters stated that the success of mitigation and sagebrush restoration is limited and the BLM and Forest Service should not use a broad-scale map as a basis for site-specific mitigation. Mitigation should be feasible and consistently applied.

Commenters also requested clarification and/or revisions to various mitigation measures, including the mitigation banking program and several BMPs/RDFs.

Response

The Mitigation, Monitoring, and Adaptive Management strategies were described more fully in **Chapter 2** and **Appendices D**, **E**, and **L** of the Draft LUPA/EIS. The Mitigation Strategy and Monitoring Framework have been updated in the Proposed LUPA/Final EIS (see **Section 2.7**, Adaptive Management, Monitoring, and Mitigation, and **Appendices D** and **E**). Additionally an Avoid, Minimize, and Apply Compensatory Mitigation Flowchart has been added in **Appendix J** to visually describe the process of application for net conservation gain. The Nevada Conservation Credit System, which is an option for compensatory mitigation in the Proposed Plan, is described in **Appendix L** of the Proposed LUPA/Final EIS. All authorizations to the extent consistent with applicable law will be required to mitigate and to achieve the net conservation gain standard.

The Draft LUPA/EIS contains planning actions and does not include site-specific implementation actions. Maps would be used for broad-scale planning purposes only. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM and Forest Service will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses and maps will tier to the plan-level analysis (EIS) and expand the environmental analysis when more specific information is known.

Mitigation would be consistently applied according to the BLM Draft Regional Mitigation Manual (BLM MS-1794).

The BLM describes RDFs as state-of-the-art mitigation measures. The aim of RDFs is to protect wildlife, air quality, landscapes, and other natural resources. BLM's policy is that all Field Offices will require RDFs to the extent consistent with applicable law in NEPA documents to mitigate anticipated impacts on surface and subsurface resources. RDFs are not "one size fits all." The actual practices and mitigation measures best suited for a particular site are evaluated through the NEPA process and vary to accommodate unique, site-specific conditions and local resource conditions. RDFs have been updated and revised in the Proposed Plan (see **Appendix D**).

C.2.5 ACECs

Range of Alternatives

Summary

BLM has not provided sufficient details regarding relevance and importance criteria such as population numbers and critical needs in the specifically identified areas, or consideration for other administrative designations besides ACECs to manage GRSG habitat.

Response

In general, when determining the Relevance values for a potential ACEC, a wildlife resource consists of but is not limited to habitat for endangered, sensitive, or threatened species or habitat essential for maintaining species diversity. Specific population numbers are not identified as a requirement for a Relevance value. Population numbers are not identified for Importance values, which requires that the resource have a substantial significance and value to satisfy this criterion. Importance values require that the resource have special worth, consequence, meaning, distinctiveness, or cause for concern. Other values can include:

- Sensitive, endangered, threatened, or vulnerable to adverse change
- Warrants special protection to satisfy national priority concerns or mandates of FLPMA

Section 1.3, Purpose and Need of the Draft LUPA/EIS and Proposed LUPA/Final EIS provide the rational for the critical need to protect GRSG populations. Within the range of alternatives, the Draft LUPA/EIS presented and analyzed management actions to protect GRSG, some of which included ACECs. For example, Alternatives C and F proposed to establish ACECs for the protection and management of the GRSG. Alternative E has identified GRSG habitat where management would be applied as Sage-Grouse Management Areas (SGMAs), not ACECs. Alternatives B, D, and the Proposed Plan identify areas as PHMA and GHMA, which in effect are not designations such as an ACEC but still contain similarly specific management prescriptions to manage and protect GRSG and its habitat. Management prescriptions under the Proposed Plan are also applied to SFAs, which will additionally protect GRSG and its habitat. All of these management actions provide similar and equal protections for GRSG.

Best Available Information Baseline Data

Summary

BLM should consider designating priority habitat areas as potential ACECs since the habitat within these areas meet with ACEC Relevance and Importance criteria.

Response

One of the alternatives (Alternative C) included and analyzed in the Draft LUPA/EIS and Proposed LUPA/Final EIS does identify PHMA as potential ACECs. Alternative F also proposes ACEC designations in PHMA. Management prescriptions under the Proposed Plan are also applied to SFAs, which will additionally protect GRSG and its habitat.

C.2.6 Climate Change

Range of Alternatives

Summary

Commenters requested the BLM and Forest Service provide a definition of "drought" and suggested that a management action related to drought be eliminated because it would be impossible to implement.

Response

A definition of "drought" has been added to the Proposed LUPA/Final EIS glossary in **Chapter 8**, and management actions D-VEG-D 2 and D-VEG-D 3 from the Draft LUPA/FES, which included specific management related to drought, were carried forward in the Proposed Plan as part of the Proposed LUPA/Final EIS (see, for example, Proposed Plan Objective CC 2). The BLM has and will continue to implement drought management policies.

The BLM and the Proposed Plan follows a current policy on drought. The BLM monitors changing vegetative conditions, including changes that may result from drought and other climate-related impacts.

Best Available Information Baseline Data

Summary

Commenters questioned the accuracy of the information included in **Chapter 3** and its ability to support the impact analysis in **Chapter 4**.

Commenters also stated that BLM needs to ensure the assumptions used for impact analysis are consistent with and supported by the baseline climate change analysis in **Chapter 3**.

Response

As described above, the BLM and Forest Service complied with NEPA requirements regarding the use of best available information and relevant information on which to base decisions. For example, the BLM and Forest Service used the Baseline Environmental Report (Manier et al. 2013) to identify and inform current landscape conditions. The climate change forecasts used in **Chapter 3** help determine the future baseline conditions for the planning area. These forecasts were analyzed in the Central Great Basin Ecoregional Assessment and used the same models as the 2007 Intergovernmental Panel on Climate Change Fourth Assessment Report. The accuracy of the use of climate change models is discussed in **Chapter 3**. The analysis in **Chapter 4** displays how management actions would allow resources and programs to adapt to these forecast changes.

The assumption in **Chapter 4** related to water availability and climate change has been revised to be consistent with the **Chapter 3** baseline analysis.

Impact Analysis

Summary

Commenters stated that the Draft LUPA/EIS incorrectly concludes that impacts on climate change under Alternative E would be the same as Alternative A. Commenters argue the impacts are different because Alternative E constrains resource use and would decrease greenhouse gas emissions associated with particular uses.

Response

The Proposed LUPA/Final EIS includes updated impact analysis under Alternative E to clarify the climate change impacts associated with that alternative. **Chapter 4** specifically states that Alternative E does not outline specific management actions but is expected to result in fewer impacts on climate change than Alternative A.

Cumulative Impact Analysis

Summary

Commenters argue that the Draft LUPA/EIS does not adequately address the cumulative effects of climate change on GRSG or its habitat, including the cumulative effects of livestock grazing on atmospheric greenhouse gas concentrations and the likelihood that climate change will increase the prevalence of invasive weeds.

Response

Assessing the impacts of grazing on greenhouse gas concentrations and the potential for climate change to increase the prevalence of invasive weeds is outside the scope of this document. The Proposed LUPA/Final EIS addresses the potential effects on GRSG and its habitat from grazing and invasive species as well as impacts associated with global climate change throughout **Chapters 4** and **5** and include sections dedicated to climate change analysis (see **Sections 4.19** and **5.18**). The Proposed LUPA/Final EIS includes strategies to address potential climate change effects (see Proposed Plan Objectives CC 1 and 2, and Action CC 1 and 2).

C.2.7 Cultural Resources

No comments are associated with this issue.

C.2.8 Fire and Fuels

Summary

Clearly define how readjustment of resources to provide suppression for GRSG habitat would be coordinated with the local fire departments. Nevada Rural Electric Association requests the flexibility to fight wildfire that threaten their infrastructure within authorized ROWs and requests application of the Rangeland Fire Protection Association model to all Draft LUPA/EIS alternatives.

Response

The Proposed Plan has specific goals, objectives, and actions for coordination and collaboration with federal, tribal, state, local governments, as well as associations sanctioned through either California or Nevada states that meet fire standards for effective and efficient wildfire response (see for example, the Proposed Plan Goal SSS 1, Action SSS 6 and Action WFM 5).

Range of Alternatives

Summary

The preferred alternative must include provisions for habitat restoration and methods to procure the funding to complete the projects. There is a need for active management in tree removal because without disturbance, woodlands will continue to expand, mature, and close. Prioritize restoration in seasonal habitats that limiting GRSG distribution and/or abundance and where factors causing degradation have already been addressed. Where it will achieve GRSG habitat objectives, passive restoration approaches should be favored over active methods. Include statement regarding no burning in less than 12-in precipitation zones.

Response

Active and passive fire management varies based on a site-specific basis and specific variables in that area. Exclusively passive restoration is considered in Alternatives C and F. As part of the Proposed Plan, the BLM and Forest Service planning units (Districts and Forests), in coordination with the USFWS and relevant state agencies, would complete and continue to update GRSG Landscape Wildfire and Invasive Species Habitat Assessments to prioritize at-risk habitats, and identify fuels management, preparedness, suppression and restoration priorities necessary to maintain sagebrush habitat to support interconnecting GRSG populations. These assessments and subsequent assessment updates would also be a coordinated effort with an interdisciplinary team to take into account other GRSG priorities identified in this plan. **Appendix G** describes a minimal framework example and suggested approach for this assessment. The Proposed Plan and **Appendix G** (FIAT) also discuss the full range of fuels techniques that include both passive and active restoration. Alternative B in the Draft LUPA/EIS and the Proposed LUPA/Final EIS would restrict prescribed burning for areas that receive less than 12 inches of precipitation a year. Alternative D in the Draft LUPA/EIS and the Proposed LUPA/Final EIS addresses the management of conifer encroachment and addresses management of invasive woodlands that threaten GRSG because these habitats do not support GRSG. In the Proposed LUPA/Final EIS, the BLM provides a criteria-based approach for prescribed fire in GRSG habitat (Action WFM-HFM 5). The Forest Service Plan is more restrictive and does not generally allow for prescribed fire burning in less than 12 inch precipitation zones.

Best Available Information Baseline Data

Summary

Commenters suggested that BLM needed to support their information in the affected environment chapter with additional references. Commenters also provided several new/additional references that BLM should consider in the EIS.

Response

Chapter 3, Affected Environment, of the Draft LUPA/EIS and Proposed LUPA/Final EIS provide the appropriate information for the scope and scale of the project (see **Section 2.1**, NEPA Baseline Information of this report). However, upon BLM and Forest Service reviews and public comment suggestions, some sections in Chapter 3 have been updated and revised to include clarifications or new information. The new information does not present a significantly different picture of the impacts, and/or that the information submitted/used in the PRMP would not result in impacts that were not previously considered and analyzed within the spectrum of the alternatives in the DEIS.

Chapter 3 in the Proposed LUPA/Final EIS has been revised throughout to include additional reference support, including the information presented by commenters, and was revised to clarify criteria used for the baseline assessments in several program areas.

Additionally, the BLM and Forest Service reviewed many of the suggested studies and references put forth by the commenters, to determine: (1) if they presented new information that would need to be incorporated into the Proposed LUPA/Final EIS, (2) were references already included in the Draft LUPA/EIS, or (3) if the references provided the same information as already used or described in the Draft LUPA/EIS. The BLM found that the majority of the studies and references put forth by commenters were already included or provided the same information as used in the DEIS.

Based on this review, the following are examples of the new documentation supporting the Proposed LUPA/Final EIS Wildland Fire Management analysis:

- Chambers, Jeanne C.; Pyke, David A.; Maestas, Jeremy D.; Pellant, Mike; Boyd, Chad S.; Campbell, Steven B.; Espinosa, Shawn; Havlina, Douglas W.; Mayer, Kenneth E.; Wuenschel, Amarina. 2014. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: A strategic multi-scale approach. Gen. Tech. Rep. RMRS-GTR-326. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 73 p.

- Chambers, Jeanne C. and Mike Pellant. 2008. "Climate Change Impacts on Northwestern and Intermountain United States Rangelands." Rangelands 30(3):29-3.
- Fire and Invasives Assessment Team. 2014. Greater Sage-Grouse Wildfire, Invasive Annual Grasses and Conifer Expansion Assessment (Fire and Invasives Assessment Tool [FIAT]). June 2014. 43pp.
- Miller, Richard F., Jeanne C. Chambers, David A. Pyke, Fred B. Pierson, and C. Jason Williams. 2013. A Review of Fire Effects on Vegetation and Soils in the Great Basin Region: Response and Ecological Site Characteristics. Gen. Tech. Rep. RMRS-GTR-308. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 126 p.
- Miller, Richard F.; Chambers, Jeanne C.; Pellant, Mike. 2014. A field guide for selecting the most appropriate treatment in sagebrush and piñon-juniper ecosystems in the Great Basin: Evaluating resilience to disturbance and resistance to invasive annual grasses, and predicting vegetation response. Gen. Tech. Rep. RMRS-GTR-322. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 66 p.
- The Science Analysis of the National Cohesive Wildland Fire Management Strategy. 2015 Internet Website: http://cohesivefire.nemac.org/ Accessed on March 16, 2015

The BLM's consideration and analysis of the aforementioned studies that were incorporated into the analysis of the Proposed Plan would not change the impacts analysis in a way not already considered in the DEIS.

Impact Analysis

Summary

Commenters argued that placing more limitation on mineral development will not indirectly decrease risk of fire; this assumptive unsubstantiated statement and should not be include in the Proposed LUPA/Final EIS document. Commenters stated the LUPA/EIS should include citations/information detailing how development of mineral resources introduces additional ignition sources.

Commenters stated the LUPA/EIS should clarify how the elimination of cross-country travel will show significant changes in human caused ignition or a reduction of invasive grasses.

Commenters also stated that the impacts on fire and fuels management under Alternate E would not be the same as under Alternative A because Alternative E provides for the use of livestock grazing for fuels reduction.

Clarify what is meant by "sagebrush cover will be maintained or increased to cover at least 70 percent of the land."

Response

The assumption that reducing mineral activity (DEIS page 4-127) is based on Shlisky et al 2007, which shows a correlation between mining and risk of wildfire by introducing new ignition sources. Regarding the correlation between cross-country travel and fire, see **Section 4.8.3** of the Draft LUPA/Final EIS. Alternative E would use livestock grazing when appropriate as a management tool to improve GRSG habitat quantity and quality or to reduce wildfire threats. Based on a comprehensive understanding of seasonal GRSG habitat requirements, and in conjunction with the need for flexibility in livestock operations, Alternative E includes timely, seasonal range management decisions to meet vegetation management objectives. This includes fuels reduction, but no AUMs would be reduced.

As FRCCs are improved over the planning period, there should be movement toward a natural fire regime and a reduced risk of uncharacteristic wildfire. Vegetation would become more resistant and resilient and less likely to lose key ecosystem components after a disturbance. This could decrease fire size, intensity, and management costs. Compared to Alternative A, there would be more areas improving FRCCs.

Increasing or maintaining sagebrush cover so that at least 70 percent of the land cover provides adequate sagebrush habitat to meet sagebrush needs is an objective identified in the NTT report and included as a vegetation objective in the Proposed LUPA/Final EIS (Objective VEG 1).

Mitigation Measures

Summary

Emergency response to wildfires should be included in the plan and should include the use of air tankers. Additionally, the Rangeland Fire Protection Association model should be applied to all Draft LUPA/EIS alternatives.

Response

The Proposed LUPA/Final EIS in **Chapter 2** of the BLM Proposed Plan Action WFM-SU 9 states that the BLM would use retardant and mechanized equipment to minimize burned acreage during initial attack. Similarly, under the Forest Service Plan: GRSG FM-GL-015 Guideline provides for this requirement.

Action WFM 5 in the Proposed LUPA/Final EIS identifies that BLM and the Forest Service will coordinate and collaborate with federal, tribal, state, and local governments and associations sanctioned through either California or Nevada that meet fire standards for effective and efficient wildfire response. Associations as used in this action are the same as Rangeland Fire Protection Associations.

C.2.9 Fish and Wildlife

Summary

Adequate predator control measures need to be undertaken to limit predator populations as part of this decision.

Response

Alternative E in the Draft LUPA/ EIS addressed predator control; however, predator population control itself was included in Chapter 1 of the Draft LUPA/EIS under Issues Eliminated from Detailed analysis. The Proposed LUPA/Final EIS includes an objective and four management actions to address predation of GRSG in the Proposed Plan. Additional clarification regarding predator population control has also been added to **Section 1.5**, Development of Proposed Land Use Plan Amendment.

C.2.10 Other Special Status Species

Summary

Intensive GRSG management may have unintentional effects on other species outside of PPH/PGH.

Response

The Draft LUPA/EIS discussed this topic (see **Section 3.5**, Fish and Wildlife and Special Status Species in the Draft LUPA/EIS) and addresses impacts on SSS in **Section 4.7**. This topic is also addressed through the Biological Assessment for Section 7 Consultation with the USFWS (**Appendix W**). In addition, the Forest Service developed a Biological Evaluation (see **Appendix Q**) of this Proposed LUPA/Final EIS). Effects on other species would be evaluated at the site-specific level during implementation.

Impact Analysis

Summary

Single-species management will put GRSG and sagebrush habitat above other habitats mainly conifer and associated species.

Response

The purpose of this planning effort is to identify and incorporate appropriate GRSG conservation measures. **Sections 3.3**, Vegetation, and **Section 3.5**, Fish, Wildlife, and Special Status Species, in the Proposed LUPA/Final EIS discuss the use of sagebrush habitat by other species. These sections describe the general impacts on sagebrush ecosystems that would apply to all sagebrush-dependent species. **Appendix Q** further describes how management actions for the conservation of GRSG relate to other sensitive species, including those associated with sagebrush habitats. The Proposed LUPA/Final EIS also identifies acres of conifer treatment through the VDDT (**Appendix M**), and the FIAT (**Appendix G**) establishes a process for identifying priority areas for treatment. Management considerations for sensitive species will continue to follow current BLM and Forest Service policy. Further, vegetation treatments will be analyzed through the NEPA process at the site-specific project level.

C.2.11 Lands and Realty

Range of Alternatives

Summary

Commenters requested clarification or recommended specific changes to proposed management.

Commenters requested that BLM exempt all utility corridors from GRSG restrictions.

Response

The BLM and Forest Service complied with NEPA and the CEQ implementing regulations at 40 CFR 1500 in the development of alternatives for this Draft LUPA/EIS, including seeking public input and analyzing reasonable alternatives. The alternatives include management options for the planning area that would modify or amend decisions made in the field/district office and forest LUPs, as amended, to meet the planning criteria, to address issues and comments from cooperating agencies and the public, or to provide a reasonable range of alternatives.

Management actions included in the Draft LUPA/EIS for the co-location of new infrastructure within existing ROWs, corridors, or communication lease areas are intended to reduce the amount of surface disturbance in GRSG habitat and concentrate new development in habitat areas already affected by anthropogenic activities.

The BLM and Forest Service recognize that co-location is not feasible or appropriate in all circumstances, particularly for new power lines. Under all alternatives in the Proposed LUPA/Final EIS, the BLM and Forest Service would continue to review proposed infrastructure projects on a case-by-case basis within and outside GRSG habitat. Management actions include the co-location of new ROWs or Forest Service Special Use Authorizations (SUAs) within existing ROWs or SUAs to achieve net conservation gain in PHMAs. The Proposed LUPA/Final EIS analyzes management actions and the placement of new ROWs in corridors (see, for example, Proposed Plan Actions LR LUA 1 through LR LUA 3).

Best Available Information Baseline Data

Summary

The Draft LUPA/EIS does not reference all relevant studies, policies, or regulations related to lands and realty actions (e.g., conversion of GRSG habitat to agricultural lands). Commenters suggested that the BLM and Forest Service should have considered several additional references in their analysis related to the relationship between GRSG and transmission lines. For example, commenters noted the Draft LUPA/EIS did not include studies that found underground power lines have more environmental impacts than overhead power line placement.

Commenters also requested clarification on specific terminology used in the lands and realty analysis.

Response

The CEQ regulations require an environmental impact statement to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The description shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues" (40 CFR 1502.15). Additionally, the Nevada and Northeastern California Greater Sage-Grouse LUPA/EIS is a programmatic NEPA effort to conserve GRSG and its habitat across a broad geographic area. As such, the BLM and Forest Service described the current conditions and trends in the affected environment broadly, across a range of conditions, appropriate to program-level land use planning actions.

Before beginning the Nevada and Northeastern California LUPA/EIS and throughout the planning effort, the BLM and the Forest Service considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level. A National Technical Team (NTT) was formed as an independent, science-based team to ensure that the best information to manage the GRSG is reviewed, evaluated, and provided to the BLM and the Forest Service in the planning process. The group produced a report in December 2011 that identified science-based management considerations to promote sustainable GRSG populations. The NTT is staying involved as the BLM and the Forest Service work through the strategy to make sure that relevant science is considered, reasonably interpreted, and accurately presented, and that uncertainties and risks are acknowledged and documented.

A baseline environmental report, *Summary of Science, Activities, Programs, and Policies That Influence the Range wide Conservation of Greater Sage-grouse (Centrocercus urophasianus)* (referred to as the BER), was released on June 3, 2013, by the US Geological Survey. The peer-reviewed report summarizes the current scientific understanding about the various impacts on GRSG populations and habitats and addresses the location, magnitude, and extent of each threat. The BER report does not provide management options. The report is being used by the BLM and the Forest Service in its efforts to develop regulatory mechanisms and improve conservation efforts of the GRSG and its habitat to reduce the potential for listing it under the Endangered Species Act. The data for this report were gathered from BLM, Forest Service, and other sources and were the "best available" at the range-wide scale at the time collected.

In March 2013, a team of State and USFWS representatives released the COT Report based upon the best scientific and commercial data available at the time that identifies key areas for GRSG conservation, key threats in those areas, and the extent to which they need to be reduced for the species to be conserved. The report serves as guidance to federal land management agencies, State GRSG teams, and others in focusing efforts to achieve effective conservation for this species.

Additionally, GRSG conservation measures in *A Report on National Greater Sage-grouse Conservation Measures* (NTT 2011) were used to form BLM and the Forest Service management direction under at least one alternative, which is consistent with the direction provided in BLM Washington Office Instruction Memorandum 2012-044.

The BLM and the Forest Service complied with CEQ regulations in describing the affected environment and when providing scientific justification for the nature and types of impacts described in **Chapter 4**, Environmental

Consequences. Of the suggested studies and references put forth by the commenters, the BLM and Forest Service reviewed them to determine if they presented new information that would need to be incorporated into the Proposed LUPA/Final EIS, were references already included in the Draft EIS, or if the references provided the same information as already used or described in the Draft EIS. The BLM and Forest Service determined that the new information provided by the commenters does not present a significantly different picture that would change the analysis, and/or that the information submitted/used in the Proposed LUPA/Final EIS would not result in analysis that was not previously considered in the Draft LUPA/EIS.

While land use planning-level decisions are broad in scope, the BLM and Forest Service did perform a thorough review of the EIS's baseline data relevant to lands and realty when preparing the Draft LUPA/EIS. The Proposed Plan includes information to provide the necessary basis to make informed land use plan-level decisions. See **Section 2.1**, Changes Between Draft LUPA/EIS and the Proposed LUPA/Final EIS for changes related to the lands and realty program.

Regarding conversion of BLM-administered and National Forest System lands for agricultural use via the Desert Lands Entry Act, the Draft LUPA/EIS precluded disposal of PPH in the land tenure section; the Proposed LUPA/Final EIS precludes the disposal of PHMA and GHMA. For Desert Lands Entry actions, lands have to be identified for disposal. Therefore, no Desert Lands Entry actions would be allowed under the Proposed LUPA/Final EIS in PHMA or GHMA.

While the placement of power lines underground may result in greater short-term GRSG habitat disturbance, over the long term and following appropriate reclamation of the surface above underground lines, there would be less surface disturbance.

A definition of 'no longer in service' was not included in the Draft LUPA/EIS, but a definition for "no longer in use" is included in the Proposed LUPA/Final EIS in **Chapter 8**, Acronyms and Glossary.

The Proposed LUPA/Final EIS includes management actions for the placement of infrastructure. These parameters have been determined through scientific studies (see, for example, **Table 2-6**, GRSG habitat objectives in the Draft LUPA/EIS, which has been updated and is now **Table 2-2**, Proposed Habitat Objectives for GRSG, in the Proposed LUPA/Final EIS).

The Proposed LUPA/Final EIS includes a definition of "utility-scale" in the **Chapter 8** glossary. A facility that generates 20MW or more of electricity is considered utility-scale.

Impact Analysis

Summary

Commenters had concerns regarding proposed management actions in the Draft LUPA/EIS related to new and existing ROW development, particularly the comparative benefits for GRSG habitat from underground versus overhead power line placement, and the technical and financial barriers associated with undergrounding or locating new power lines and communication infrastructure in or adjacent to existing ROWs, and potential limitations on the expansion of existing infrastructure.

Commenters noted that the BLM and Forest Service did not fully analyze the adverse and beneficial direct and indirect effects of proposed lands and realty and renewable energy management actions identified in the Draft LUPA/EIS. For example the relationship between lands and realty management and the fire and fuels program, consistency with the Solar PEIS, and long- and short-term impacts.

Commenters also noted that the BLM and Forest Service did not adequately address the effects on lands and realty from biofuel activities.

Response

As discussed in the Draft LUPA/EIS, the placement of power lines underground may result in greater short-term GRSG habitat disturbance, but over the long term and following appropriate reclamation of the surface above the underground lines, there would be less surface disturbance. Considerations of costs associated with undergrounding are solely within the purview of the Nevada and California Public Utilities Commissions and are outside the scope of the LUPA/EIS.

The Draft LUPA/EIS and Proposed LUPA/Final EIS provide adequate discussions of the environmental consequences, including the cumulative impacts, of the presented alternatives. **Section 4.9**, Wildland Fire and Fire Management and **Section 4.13**, Lands and Realty, in the Proposed LUPA/Final EIS analyze the effects of lands and realty on fire management. As required by 40 CFR 1502.16, the Draft LUPA/EIS and Proposed LUPA/Final EIS provide a discussion of the environmental impacts of the alternatives, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented. The Draft LUPA/EIS and Proposed LUPA/Final EIS provides sufficiently detailed information to aid in determining whether to proceed with the preferred alternative or make a reasoned choice among the other alternatives in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1.

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29; Forest Service Handbook 1909.12 – Land Management Plan+C6ning). The Draft LUPA/EIS contained only planning actions and did not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM and the Forest Service will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

The placement of power lines underground may result in greater short-term GRSG habitat disturbance, but over the long term and following appropriate reclamation of the surface above underground lines, there would be less surface disturbance. Application of RDFs and reclamation standards address invasive weeds during construction activities, such as undergrounding power lines.

Under the Proposed LUPA/Final EIS, PHMA and GHMA would be managed as exclusion for solar energy development consistent with the Solar Programmatic EIS (PEIS). Areas where solar variance zones identified in the Solar PEIS overlap GRSG habitat would also be managed as exclusion areas even though they were not excluded in the PEIS. The relationship between fire and fuels is addressed in **Chapter 4** in the Proposed LUPA/Final EIS (see Shlisky 2007). The BLM and Forest Service are not creating incentives for the creation or facilitation of a biomass industry; any incentivization of biofuels is outside the scope of this LUPA/EIS.

The application of anti-perch devices for existing structures would be evaluated at the time of ROW renewal or amendment on a case-by-case basis.

BLM added the definition of distribution lines, which is included in the Proposed LUPA/Final EIS **Chapter 8**, Glossary. Impacts from transmission and distribution lines vary and would be analyzed on a case-by-case basis. Appropriate mitigation and RDFs for the type of infrastructure would be imposed on all ROWs within GRSG habitat depending on findings from the environmental analysis for the project.

Cumulative Impact Analysis

Summary

Commenters stated that the Draft LUPA/EIS does not consider the cumulative impacts from the Mt. Hope EIS or wind energy projects at China Mountain and the Diamond Range. The Draft LUPA/EIS does not provide additional information on projects that are reasonably foreseeable future actions.

Response

The BLM and the Forest Service thoroughly explained its consideration and analysis of cumulative effects in the Draft LUPA/EIS in **Chapter 5**. The Draft LUPA/EIS considered the past actions to the extent that they are relevant, as well as present and reasonably foreseeable (not highly speculative) federal and non-federal actions (see **Table 5-39)**. The cumulative effects analysis in the Draft LUPA/EIS was completed for each of the alternatives using the reasonably foreseeable actions. As such, the BLM and the Forest Service have complied fully with the requirements of 40 CFR 1508.7 and prepared a cumulative impact analysis based on the broad nature and scope of the proposed management options under consideration at the land use planning level. The Draft LUPA/EIS considered past actions, to the extent that they are relevant, and present and reasonably foreseeable (not highly speculative) federal and non-federal actions, taking into account the relationship between the proposed alternatives and these reasonably foreseeable actions.

In addition, the Draft LUPA/EIS contained a qualitative discussion of cumulative impacts at the WAFWA Management Zone level, and the Proposed LUPA/Final EIS contains a quantitative discussion based off of additional information, including information from GRSG planning efforts in adjacent sub-regions.

The BLM and Forest Service identified existing wind energy ROW applications, including the China Mountain project, in **Table 5-39** of the Draft LUPA/EIS. A decision on the China Mountain wind project has been temporarily deferred. All proposed development plans will be reviewed for consistency with the amended land use plan.

The Mt. Hope EIS relates to a mineral development project and is addressed in the minerals section. The Mt. Hope record of decision was issued in 2012. Development at the mine site and of the ancillary transmission line is currently on hold.

As of the date of this Proposed LUPA/Final EIS issuance, the BLM has not received a development application for a potential wind project on the Diamond Range.

Mitigation Measures

Summary

Commenters noted that mitigation requirements for new electrical transmission infrastructure identified in **Appendix A**, Required Design Features, of the Draft LUPA/EIS did not properly consider site-specific applications or benefits to GRSG; did not incorporate relevant information from the Avian Power Line Interaction Committee; did not differentiate types of mitigation between transmission and distribution lines; and may not be feasibly implemented due to costs.

Response

The BLM and the Forest Service complied with NEPA by including a discussion of measures that may mitigate adverse environmental impacts of the alternatives in the Draft LUPA/EIS. See 40 CFR 1502.14(f), 1502.16(h). Potential forms of mitigation include: 1) avoiding the impact altogether by not taking a certain action or parts of an action; 2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; 3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; 4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or 5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20). Not taking action, such as differentiating types of mitigation between transmission and distribution lines, is only one of many potential forms of mitigation. The BLM and the Forest Service must include mitigation measures in an EIS pursuant to the NEPA; yet the BLM and the Forest Service have full discretion in selecting which mitigation measures are most appropriate, including which forms of mitigation are inappropriate.

Additionally, site-specific concerns and more detailed environmental descriptions will be addressed when project-level reviews are tiered to the analysis in this EIS (40 CFR 1502.20, 40 CFR 1508.28). In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for any site-specific actions. Mitigation has been further defined as a Regional Mitigation Strategy and is detailed in **Appendix I** of the Proposed LUPA/Final EIS. The strategy is incorporated in the Nevada and Northeastern California Greater Sage-Grouse Proposed LUPA/Final EIS and was developed to achieve a net conservation gain to the species by implementing conservation actions. Regional mitigation is a landscape-scale approach to mitigating impacts on resources. This involves anticipating future mitigation needs and strategically identifying mitigation sites and measures that can help achieve the greatest conservation benefit for GRSG and its habitats.

If impacts on GRSG or its habitat from authorized land uses remain after applying avoidance and minimization measures, then compensatory mitigation projects will be used to fully offset impacts to achieve conservation benefits. Any compensatory mitigation will be durable, timely, and in addition to that which would have resulted without the compensatory mitigation.

Specific mitigation strategies, based on the strategy, will be developed by regional teams within one year of the issuance of the Record of Decision and be consistent with the BLM's Regional Mitigation Manual MS-1794, Forest Service Handbook FSH 1909.15, and CEQ regulations at 40 CFR 1508.20.

Required design features, consistent with applicable law, are included in **Appendix D** of the Proposed LUPA/Final EIS. In the Draft LUPA/EIS, RDFs varied across the alternatives, and the analysis reflected the differences under each alternative. While the types of mitigation would be similar for distribution and transmission lines, specific mitigation strategies would vary for these two different lines and would be analyzed on a case-by-case basis. Appropriate mitigation and RDFs for the type of infrastructure would be imposed on all new, renewed, or amended ROWs within GRSG habitat depending on findings from the environmental analysis for the project. Recommendations from the Avian Powerline Study would be applied at the site-specific implementation level as appropriate.

C.2.12 Leasable Minerals

Range of Alternatives

Summary

The BLM and Forest Service should provide additional detail and/or revisions regarding leasable minerals alternatives, including provisions for an appeal process associated with SSUS-3 (see **Appendix G** in the Draft LUPA/EIS), requiring reclamation instead of restoration, and specifying an NSO buffer distance. All priority habitats should be found unsuitable for coal leasing to provide regulatory certainty.

Commenters asserted Alternative B management (specifically application of the 3% disturbance cap) is inappropriate for existing leases, and mitigation requirements prior to disturbance are not within BLM's jurisdiction, as mitigation cannot be required as a term of a lease.

Commenters noted that restoration is too rigorous of a standard to meet, and the term should be replaced with reclamation with the type of plant community specified at the time of the bond development.

Response

The establishment of an appeal process is outside the scope of work for this document. The Draft LUPA/EIS is consistent with current BLM and Forest Service RDFs for restoration (see RDFs incorporated as part of the Proposed Plan). These planning decisions are not taking away any appeal/administrative processes or creating any new processes. Plan decisions are protestable, and site-specific decisions would be subject to any applicable regulatory administrative process that is provided.

Restoration will continue to be used in the Proposed LUPA/Final EIS. The purpose of the Proposed LUPA/Final EIS is to improve GRSG and its habitat and may require more rigorous actions land used in previous land use plans.

Lek buffer distances in the Proposed Plan alternative of the Proposed LUPA/Final EIS include those identified in the USGS Report "Conservation Buffer Distance Estimates for Greater Sage-Grouse – A Review" (Open File Report 2014-1239) (see **Appendix A)**. Additionally, the Proposed LUPA includes an NSO stipulation; it would be applied for leases within PHMAs at the time of leasing only, but would not be applied to existing oil and gas leases that did not include a No Surface Occupancy stipulation at the time of leasing. No waivers or modifications to an oil and gas lease NSO stipulation would be granted, apart from two criteria whereby the Authorized Officer may grant the exception. See the Proposed Plan management actions in **Chapter 2** of the Proposed LUPA/Final EIS.

According to 43 CFR 3461.2-1(a) (1), the BLM shall apply the unsuitability criteria to all coal lands with development potential identified in the comprehensive land use plan. There are no lands with coal development potential identified in the planning area; therefore, the unsuitability criteria are not applied.

The 3% disturbance cap for all land ownership within PHMA does not affect valid existing rights. Existing disturbance would be calculated towards the cap but would not operate to preclude existing rights (see **Appendix F**). Where a proposed fluid mineral development project on an existing lease could adversely affect GRSG populations or habitat, the BLM will work with the lessees, operators, or other project proponents to avoid, reduce, and mitigate adverse impacts to the extent compatible with lessees' rights to drill and produce fluid mineral resources. The BLM will work with the lessee, operator, or project proponent in developing an APD for the lease to avoid and minimize impacts on GRSG or its habitat and will ensure that the best information about the GRSG and its habitat informs and helps to guide development of such federal leases. Additional information for application of and calculations for the disturbance cap can be found in **Appendix F** of the Proposed LUPA/Final EIS.

Best Available Information Baseline Data

Summary

Commenters suggested additional literature for the BLM and Forest Service to consider, including in the Proposed LUPA/Final EIS. Topics of concern included noise, geothermal resources, and hydraulic fracturing.

The BLM and Forest Service need to forecast the number of wells expected to be drilled in PHMA and GHMA under each alternative.

Response

As noted in **Section C.2.1**, Baseline information in this report, the CEQ regulations require an environmental impact statement to "succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration."

The affected environment provided in **Chapter 3** and the RFD appendix in the Draft LUPA/EIS were sufficient to support, at the general land use planning-level of analysis, the environmental impact analysis resulting from management actions presented in the Draft LUPA/EIS.

Hydraulic fracturing would not increase the number of exploration wells. It is used to enhance production. Therefore, this technology would not modify the RFD scenario in the Draft LUPA/EIS.

The Proposed LUPA/Final EIS (**Appendix P** and **Table 3-51**) also includes updated information on geothermal potential. Based on the new information, the Proposed LUPA/Final EIS includes a revised RFD for geothermal.

Noise-related impacts on GRSG habitat are analyzed in the Draft LUPA/EIS and have been further refined in the Proposed LUPA/Final EIS. Impacts on mineral development from noise mitigation measures (e.g., buffers/set-backs) have been further addressed in the Proposed LUPA/Final EIS based on the management actions in the Proposed Plan.

The number of new wells anticipated in the planning area is described in **Appendix P,** Oil and Gas RFDs of the Draft LUPA/EIS. New wells would be precluded in PHMAs under Alternatives B, C, and F. The Proposed Plan would include an NSO restriction in PHMA.

Impact Analysis

Summary

The BLM and Forest Service should provide a quantitative context for impacts. Commenters also had concerns about the impacts on fluid mineral development from NSO stipulations without modifications, waivers, and exceptions.

Response

Quantitative context for current and future disturbance associated with fluid minerals can be found in **Appendix P**, Oil and Gas RFDs of the Draft LUPA/EIS.

The Proposed LUPA/Final EIS would apply an NSO stipulation to PHMA with exceptions. GHMA would be managed under moderate constraints (controlled surface use and timing limitations). These stipulations are analyzed throughout **Chapter 4** of the Proposed LUPA/Final EIS, including within **Section 4.15.1**, Fluid Minerals and in the other program areas. The rationale for the NSO stipulation without waivers, exceptions, or modifications is part of Alternative D in the Draft LUPA/EIS and Proposed LUPA/Final EIS; however, the range of other alternatives allows for exceptions, modifications, or waivers.

Cumulative Impact Analysis

Summary

The cumulative impacts analysis is incomplete and inconsistent with other sections of the Draft LUPA/EIS.

Response

The Draft LUPA/EIS considered the past actions to the extent that they are relevant, and present and reasonably foreseeable (not highly speculative) federal and non-federal actions (see **Table 5-39**). The cumulative effects analysis in the Draft LUPA/EIS was completed for each of the alternatives using the reasonably foreseeable actions. In addition, the Draft LUPA/EIS contained a qualitative discussion of cumulative impacts at the WAFWA Management Zone level, and the Proposed LUPA/Final EIS contains a quantitative discussion based off of additional information, including information from GRSG planning efforts in adjacent sub-regions.

This discussion summarizes CEQ guidance from June 24, 2005, stating that "[g]enerally, agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." This is because a description of the current state of the environment inherently includes the effects of past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The CEQ interpretation was accepted by the Ninth in NW Envtl. Advoc. v. Nat'l Marine Fisheries Serv., 460 F.3d 1125, 1141 (9th Cir. 2006). The BLM and the Forest Service explicitly described their assumptions regarding proposed projects and other reasonably foreseeable future actions. On National Forest System lands, reasonably foreseeable actions are those that would occur under their current land use plans from a broad-scale perspective.

The Proposed LUPA/Final EIS has addressed cumulative impacts analyses that were incomplete and inconsistent with other sections of the Draft LUPA/EIS.

Mitigation Measures

Summary

Off-site mitigation is not a viable conservation strategy, as evidenced by research in Wyoming. Commenter notes that Alternative B would require mitigation prior to leasing. Commenter noted that disturbance cap may drastically curtail mineral development in the affected areas, thereby restricting the ability to develop according to existing lease terms (per BLM form 3100-11).

Response

The BLM considers off-site mitigation a viable tool in the GRSG conservation strategy to facilitate mineral development.

The alternatives considered in the Proposed LUPA/Final EIS do not contemplate pre-leasing mitigation, as this is not a land use planning-level decision.

The Draft EIS and the Proposed Plan in the Proposed LUPA/Final EIS provides management actions for existing leases. The 3% disturbance threshold does not apply to valid existing leases.

C.2.13 Livestock Grazing

Summary

Multiple commenters stated that permanent retirement of grazing privileges is not authorized without Congressional action.

Response

FLPMA grants the Interior Secretary the authority to make land use planning decisions, taking into consideration multiple use and sustained yield, areas of critical environmental concern, present and potential uses of the land, relative scarcity of values, and long-term and short-term benefits, among other resource values (43USC 1711 Sec 201 (a)). 43 CFR § 4100.0-8 provides that the BLM shall manage livestock grazing on public lands in accordance with applicable land use plans. Further, the BLM may designate lands as "available" or "unavailable" for livestock grazing through the land use planning process (H-1601, Land Use Planning Handbook, Appendix C). A decision to make lands unavailable to grazing is not permanent. It is subject to reconsideration, modification, and reversal in subsequent land use plan decisions.

The Taylor Grazing Act requires that the Secretary "make such rules and regulations … [and] do any and all things necessary … to insure the objects of … grazing districts, namely, to regulate their occupancy and use, to preserve the land and its resources from destruction or unnecessary injury [and] to provide for the orderly use, improvement and development of the range" (43 USC § 315a).

FLPMA grants the Interior Secretary the authority to make land use planning decisions, taking into consideration multiple use and sustained yield, areas of critical environmental concern, present and potential uses of the land, relative scarcity of values, and long-term and short-term benefits, among other resource values (43USC 1711 Sec 201 (a)). 43 CFR § 4100.0-8 provides that the BLM shall manage livestock grazing on public lands in accordance with applicable land use plans. Actions taken under land use plans may include making some or all of the land within grazing districts unavailable for grazing during the life of the plan as well as imposing grazing use restrictions, limitations, or other grazing management-related actions intended to achieve such goals and objectives (H-1601, Land Use Planning Handbook, Appendix C).

Proposed management addressing the voluntary relinquishment (i.e., retirement or cancellation) of grazing privileges is included in the Proposed LUPA/Final EIS.

Range of Alternatives

Summary

Commenters requested that at least one alternative allow for expanding or retaining the current level of livestock grazing. Others stated that reduced utilization should be examined. Several commenters felt that grazing restrictions would violate BLM's multiple-use mandate, and that grazing can help, rather than harm, GRSG habitat.

Some California commenters pointed out that California grazing permittees are already subject to guidelines to protect GRSG, developed by the Northeast California Sage-Grouse Working Group. Therefore they oppose the guidelines in Alternative D, and suggest that California allotments be removed from the geographic scope of Nevada and Northeastern California Proposed LUPA/Final EIS. In addition, multiple commenters claimed that the proposed grazing restrictions infringe on use of existing water rights under Nevada water law, and should be revised.

Commenters pointed out the difference in type and quantity between domestic cattle and wild horses and burros, and that they constitute different types of threats to GRSG habitat. Some commenters were concerned about the imposition of one-size-fits-all rangeland health standards and habitat objectives, imposed without consideration for local conditions.

Commenters suggested specific implementation-level actions to further protect GRSG habitat and requested details on implementation-level management.

Several commenters were also concerned that an adaptive management strategy for grazing was not identified in detail in the Draft LUPA/EIS.

Response

As noted above, the Nevada and Northeastern California GRSG LUPA/EIS planning team employed the BLM and Forest Service planning process to develop a reasonable range of alternatives for the LUPA. Alternative A (No Action Alternative) analyzes a continuation of grazing at its current level. Livestock grazing is identified by USFWS as a threat to GRSG in the March 23, 2010 Federal Register Notice, and therefore it is addressed in this Draft LUPA/EIS. An alternative that would increase the amount of livestock grazing in GRSG habitat was considered but eliminated from detailed analysis because there are currently no science-based studies that demonstrate increased livestock grazing enhances or restores GRSG habitat (see **Section 2.11.3** in the Proposed LUPA/Final EIS). Existing regulatory mechanisms, including the fundamentals for rangeland health, would continue to provide the basis for managing grazing in GRSG habitat. However, the preferred alternative provided additional consistency in application of rangeland health standards relative to GRSG habitat, as well as additional guidance for prioritizing land health assessments and review of grazing permits to ensure that grazing management is compatible with attainment of GRSG habitat objectives within the planning area. In addition, RDFs would be adopted consistent with applicable law to reduce effects of range improvements and livestock trailing across public lands. Grazing use would be modified when it is identified as the cause for not meeting GRSG objectives. The intent of the land use plan amendment is to change management under all resource programs, where necessary, to benefit GRSG habitat.

Standards and Guidelines include examination of causal factors for Standard factor 8 of Rangeland Health Standards in determination.

Unless the State Director determines otherwise, the planning area for an RMP is the geographic area associated with a particular field office (43 CFR 1610.1(b)). The geographic scope of this planning effort includes the Northeast California grazing allotments; if habitat assessments indicate that GRSG habitat in those areas is meeting objectives, few changes are likely to be made to grazing conditions for those permits.

Implementation of all decisions in the Proposed LUPA/Final EIS will comply with Nevada State Water Law and valid existing rights.

The *Impacts from Wild Horses and Burros* subsection of **Sections 4.3.4** through **4.3.9** of the Draft LUPA/EIS identifies the impacts (in both type and magnitude) on GRSG habitat from wild horses and burros, while the *Impacts from Livestock Grazing* subsection of **Sections 4.3.4** through **4.3.9** of the Draft LUPA/EIS identify the impacts on GRSG habitat from domestic livestock.

The Standards for Rangeland Health in NV and CA (**Appendix K** of the Draft LUPA/EIS) were established in cooperation with local RACs and approved by the Secretary of the Interior. The proposed habitat objectives for GRSG and the guidelines for establishing allowable use levels if not meeting those objectives were developed based on the most current science (including USGS, NDOW, and Connelly and Hagen's GRSG habitat standards) and would be used to assess rangeland health of allotments prior to granting or renewing grazing permits. A toolbox of permit conditions and conservation measures such as RDFs (consistent with applicable law) would be available to District Managers when granting or renewing grazing permits, as applicable for each individual allotment within priority habitat.

Implementation-level decisions will be made at the district/forest level through the appropriate site-specific NEPA process. The Proposed LUPA/Final EIS provides guidelines, processes, and protocols, but does not make implementation-level decisions or analyze the impacts from such decisions.

Neither the Draft LUPA/EIS nor the Proposed LUPA/FIES include adaptive management hard or soft triggers for livestock grazing. The Proposed LUPA/Final EIS includes a suite of livestock grazing management strategies for achieving GRSG objectives.

Best Available Information Baseline Data

Summary

Multiple commenters requested that the Proposed LUPA/Final EIS discuss the difference between permitted and actual AUM use.

Commenters also recommended the use of the Nevada and California Rangeland Monitoring Handbook for monitoring guidelines and procedures. One commenter noted a discrepancy in the data in Tables 3.33 and 3.31 with regards to the acres meeting land health standards. Another commenter identified that the Appendix K, Livestock Grazing (Table K-1) data does not provide any date(s) that the rangeland health categories were assigned.

Commenters also stated that Section 2.4, Table 2.1 incorrectly lists grazing as a threat to GRSG habitat.

Response

As detailed above, before beginning the Draft LUPA/EIS and throughout the planning effort, the BLM and the Forest Service considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level.

The Proposed LUPA/Final EIS has been updated to include language referencing the Nevada Rangeland Monitoring Handbook.

Chapter 8 of the Proposed LUPA/Final EIS has also been updated to include definitions of "actual use" and "permitted use."

Data in **Table 3.31**, Acres of Allotments Not Meeting Land Health Standards in GRSG Habitat, has been reviewed and revised as necessary in the Proposed LUPA/Final EIS.

The dates associated with the information used for the rangeland management category assessment is identified in **Tables 3-28** and **3-29** in the Proposed LUPA/Final EIS**.**

Livestock grazing is identified by USFWS as a threat to GRSG in the March 23, 2010 Federal Register notice and the COT Report (USFWS 2013), and therefore it is addressed in this Draft LUPA/EIS. As noted in the 2010 Federal Register notice, there is little direct evidence linking grazing practices to population levels of GRSG; however, given the widespread nature of grazing, the potential for population-level impacts cannot be ignored. The *Impacts from Livestock Grazing* subsections of **Sections 4.3.4** through **4.3.9** of the Draft LUPA/EIS identify the impacts on GRSG habitat from domestic livestock use. The Proposed LUPA/Final EIS includes a suite of management actions dealing with livestock grazing actions for achieving GRSG objectives (see **Chapter 2,** Action LG 5 in the Proposed LUPA/Final EIS).

Impact Analysis

Summary

Several commenters requested detailed quantitative impact analysis for each alternative. Multiple commenters noted that Alternative A has ongoing range management regulations that have adversely affected livestock grazing (both AUMs and economic benefits), and those impacts should be discussed in the Proposed LUPA/Final EIS. Multiple commenters also stated that the conclusion that Alternatives B, D, and E would cause no further reduction in actual livestock use (and therefore no economic impact) is unsupported. Multiple commenters noted that the adverse economic impacts of Alternative C were not sufficiently developed, and/or were underestimated. One commenter noted that the road closures associated with every alternative would interfere with grazing, and this should be discussed in the Proposed LUPA/Final EIS. Some commenters were concerned that the impact analysis on livestock grazing from riparian, wetlands, and water resources was not adequate.

Response

Impacts on livestock grazing from current management are addressed in **Section 4.9.4** of the Draft EIS. This level of analysis is sufficient to support this broad land use planning-level analysis (see response to **Section 2.1**, NEPA impacts analysis, for additional details).

The Proposed LUPA/Final EIS includes analysis of the impacts from management actions on livestock grazing, including socioeconomic impacts. This information on impacts serves to assist the decision maker in making an informed decision on the selection of an Approved Plan, and also serves to provide the public an opportunity to understand the impacts of the proposed planning decisions. The socioeconomic tables in the Proposed LUPA/Final EIS analyze land use planning-level changes under all alternatives to billed AUMs (see **Section 4.20**).

While only Alternatives C and F propose land use planning changes to AUMs, all of the alternatives could potentially adjust AUMs through implementation-level decisions if rangeland health standards and GRSG objectives are not being met.

No road closures have been proposed during this land use planning process; however, during travel management implementation planning, road closures may be proposed and will be analyzed in subsequent analysis. It is important to note that any road closures would be evaluated during implementation-level planning and that closures may not apply to all uses (i.e., administrative access).

Implementation of all decisions in the Proposed LUPA/Final EIS will comply with Nevada State Water Law and will not infringe upon valid existing rights.

Cumulative Impact Analysis

Summary

Issues that commenters requested be added to the cumulative impacts discussion included: past declines in grazing and AUM utilization and the loss/fragmentation of habitat as unprofitable ranches are sold on the private market.

Response

As discussed above, the Draft LUPA/EIS considered the present effects of past actions, to the extent that they are relevant, and present and reasonably foreseeable (not highly speculative) federal and non-federal actions, taking into account the relationship between the proposed alternatives and these reasonably foreseeable actions and past actions. Information on the current conditions is more comprehensive and more accurate for establishing a useful starting point for cumulative effects analysis. The Draft LUPA/EIS contains only planning actions and does not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions.

Section 5.21 in the Proposed LUPA/Final EIS recognizes the already challenging conditions for operators of ranches and grazing operations. The baseline used to assess economic impacts of alternatives through grazing takes into consideration a 10-year average of billed AUMs, thus taking into consideration past trends.

The economic impacts analysis for grazing in **Chapter 4** in the Proposed LUPA/EIS includes the potential closure of ranches under Alternative C. This was done by adjusting AUM losses in public lands to consider the possible losses of AUMs in state or private lands as well, based on estimates from Torell et al. (2014), as explained in **Appendix V**, Economic Impact Analysis Methodology.

Site-specific analysis of grazing use is conducted as part of the land health assessment process. The Proposed LUPA/Final EIS provides the necessary information to make informed land use plan-level decisions. Specifically, a more comprehensive list of cumulative projects, past and future, has been developed and used to support a more detailed analysis of cumulative impacts.

Mitigation Measures

Summary

Multiple commenters noted that as designed, Alternative D is not flexible enough to allow for adaptive management, and suggested a 10-year plan to meet habitat objectives. Adaptive management techniques should be specifically described in the Proposed LUPA/Final EIS.

Multiple commenters urged BLM and the Forest Service to schedule and monitor rangeland health standard assessments, perhaps by developing Allotment Management Plans in coordination with permittees.

Response

The Proposed LUPA/Final EIS includes a suite of management actions dealing with livestock grazing actions for achieving GRSG objectives (see **Chapter 2,** Action LG 5 in the Proposed LUPA/Final EIS). **Chapter 2,** Action LG 4 in the Proposed LUPA/Final EIS provides the priority order for completing land health assessments in GRSG habitat. District-specific adaptive management techniques or Rangeland Health Standards assessments would not be appropriate to include in the Proposed LUPA/Final EIS; these schedules, assessments, and monitoring protocols and responsive actions would be developed during implementation of the planning decisions at the district level, in coordination with local stakeholders and permittees.

C.2.14 Locatable Minerals

Range of Alternatives

Summary

Commenters stated that the BLM should include additional management actions (including mitigation measures or withdrawal) to ensure that relocation of GRSG due to mineral extraction is not permanent. Biologists should address how mitigation would minimize the loss of PHMAs in the GRSG section of the report. The Draft LUPA/EIS includes management actions to restore locatable mineral sites to original topography; commenters asserted this is not feasible.

Management for locatable minerals under Alternatives B, C, and F is inconsistent with the 11 RMP goals, Mining Law, Manual 6840, and BLM's multiple-use mandate under FLPMA. Commenters assert an inconsistency between **Table 2-5**, Description of Alternative Actions, and **Table 2-8**, Summary of Environmental Consequences.

Response

Subject to valid existing rights and applicable law, the management actions for locatable mineral development will be implemented as necessary through NEPA compliance on a site-specific basis. The Draft LUPA/EIS does not include management actions requiring locatable mineral sites be restored. Restoration of locatable mineral sites may occur on a case-by-case basis. The Draft LUPA/EIS considered a broad range of alternatives that considers different restrictions on locatable mineral development. Recommended withdrawals are included in Alternatives B, C, and F and the Proposed Plan. Under the Proposed Plan, sagebrush focal areas (SFAs) would be recommended for withdrawal. Additionally, mitigation measures considered are outlined in **Appendix I**. Proposed management under Alternatives B, C, and F are consistent with the applicable mining laws and multiple-use mandates, but there is a range of effects on locatable minerals. The BLM and Forest Service have reviewed and revised **Table 2-17**, Summary of Environmental Consequences, as appropriate, so that it is consistent with the proposed management actions in **Table 2-15**, Description of Alternative Actions in the Proposed LUPA/Final EIS.

Best Available Information Baseline Data

Summary

Commenters stated that the Draft LUPA/EIS did not include a thorough discussion of geology.

Commenters stated that the Draft LUPA/EIS incorrectly describes the potential effects on GRSG habitat from locatable mineral development by analyzing the full claim area where development could occur, which is likely to be a larger area than the area of actual approved disturbance caused from activities.

Response

A mineral potential report is not required for land use planning efforts. The BLM has collated sufficient information to support the analysis in this broad-scale planning document. A detailed description of geology is not necessary to make an informed decision in this land use planning effort. As required by NEPA, the baseline information used in the Draft LUPA/EIS was based on the best available regional information. Mineral documentation is based on current plans of operations and interest, which limited the amount of baseline geology information available for the Draft LUPA/EIS.

The mining plan area boundary is the only feasible area to use for analysis of impacts due to mining at this level of land use planning. Locatable mineral operators may decide to develop their entire claim. GRSG is a landscape-level species accompanied by a programmatic LUPA/EIS for all of Nevada and a portion of California. Specific detail about the portion of each claim that is developed is not appropriate in this planning effort. Actual disturbance from proposed mining operations would be analyzed and permitted in accordance with BLM surface management regulations on a site-specific basis.

Impact Analysis

Summary

Commenters stated that the Draft LUPA/EIS did not comply with general mining laws and other applicable agency policies related to mineral development, which allow for environmentally responsible mineral development with appropriate mitigation.

Commenters stated that the Draft LUPA/EIS did not address impacts from regulations limiting routes and ROWs; various restrictions placed on mineral activity, for each alternative, are not analyzed or compared; and additional analysis is needed to fully address the impacts of locatable minerals.

Commenters stated that the Draft LUPA/EIS should not close lands from mineral entry until after mineral development potential has been assessed.

Response

The General Mining Law of 1872, as amended, allows for access for environmentally responsible mineral development. There are standards in place that allow the BLM to regulate the nature of access and development to prevent unnecessary or undue degradation. The BLM and Forest Service also have the authority to recommend lands for withdrawal from locatable mineral entry. As discussed in **Section 4.15.2** in the Proposed LUPA/Final EIS, impacts on locatable mineral development/access would vary and depend on site-specific conditions. Projects would be analyzed on a case-by-case basis.

Under the General Mining Law of 1872, as amended, mining claimants are guaranteed access to their locatable mineral claims, subject to approval of a plan of operations. ROWs to access mining claims are usually included as part of the plan of operations and are subject to site-specific NEPA analysis.

The Proposed LUPA/Final EIS proposes recommending SFAs for withdrawal from locatable mineral entry, while other alternatives recommended all PHMA and/or GHMA for withdrawal. Prior to withdrawal, a mineral potential report would be completed as required by agency regulations and policies.

Cumulative Impact Analysis

Summary

The BLM should clarify the total number of acres proposed for immediate and future withdrawal within the planning area and in Idaho, Montana, Oregon, and Utah and the cumulative impacts of those withdrawals across the sub-regions.

Response

Due to the variation in types of minerals and occurrence and development potential across the range, and the types of data available for the planning area compared to the entire GRSG range, cumulative impact analysis across the entire GRSG range would not provide meaningful, appropriate analysis. The total number of acres proposed for withdrawal under certain alternatives is included in each of the Great Basin sub-region Draft LUPA/EISs. The Draft LUPA/EIS has met the NEPA/CEQ requirements for cumulative impacts analysis in each of the respective sub-regional EISs. Information explaining the rationale behind the chosen geographic extent of the cumulative impact analysis area has been added to **Section 5.14.2**, Locatable Minerals, of the Proposed LUPA/Final EIS.

The cumulative effects analysis prepared for the three WAFWA Management Zones in the Nevada and Northeastern California Sub-region have been included in **Chapter 5** of the Proposed LUPA/Final EIS. **Tables 5-22** and **5-34** in the Proposed LUPA/Final EIS portray the acres recommended for withdrawal in Management Zones IV and V..

Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area that have affected and will likely continue to affect locatable minerals are existing and planned locatable mineral operations within the planning area but outside of the decision area (see **Table 5-39**). Locatable mineral resources are associated with the geological formations or units they are found within, which are typically localized and do not encompass large areas. Additionally, not all geological formations contain mineral resources, or mineral resources could be found only in a portion of a certain geological formation. To provide context for where interest in locatable mineral development is most likely within the planning area, the BLM has assessed the locatable mineral occurrence potential throughout the planning area (see **Section 3.13**, Minerals). Assessment of locatable mineral occurrence potential in the planning area allows impact analysis to focus on those areas withdrawn or recommended for withdrawal from locatable mineral entry that are actually likely to have locatable mineral resources and interest in their development. While areas outside of the Utah Sub-region may be recommended for withdrawal from locatable mineral entry as a result of decisions in other sub-regional LUPAs, expanding the cumulative impact analysis to include additional sub-regions would both dilute and inflate the impacts on locatable mineral development. Expansion of the cumulative impacts analysis area would dilute the impacts because the acres withdrawn or recommended for withdrawal across the GRSG range under the proposed plan would be minute compared to the total acreage of the range. On the other hand, expansion of the cumulative impacts analysis area would inflate the impacts because many of the acres withdrawn or recommended for withdrawal across the GRSG range do not actually have locatable mineral resources that would be impacted. While data on locatable mineral occurrence potential are available for the planning area, similar data are not available across the GRSG range. Therefore, adding up areas withdrawn or recommended for withdrawal from locatable mineral entry beyond the planning area without accounting for where such entry is foreseeable would provide a less accurate picture of the cumulative impacts on locatable mineral development.

Mitigation Measures

Summary

The BLM needs to clarify the meaning of "effective mitigation."

Response

The Proposed LUPA/Final EIS includes a mitigation strategy as an appendix (**Appendix I**). See **Appendix I** for further description of mitigation requirements.

C.2.15 Disturbance Cap

Summary

Commenters questioned the science behind the 3% disturbance cap. Comments included statements ranging from there is insufficient science to support the cap to request for consideration of additional science that does support the cap.

Response

Current literature establishes a relationship between disturbance and GRSG occupancy and persistence. The 3% disturbance cap was derived from several scientific papers, including Holloran 2005, Walker et al. 2007, Doherty et al. 2008, Doherty et al. 2011 and Naugle et al. 2011a, b. Based on these studies and professional judgment from the NTT, the 3% cap was developed. Two additional papers (Kirol 2012 and Knick 2013) in particular establish thresholds of disturbance related to development and GRSG persistence. Additional guidance for implementation of and calculations for the disturbance cap has been added to the Proposed LUPA/Final EIS in **Appendix F**.

C.2.16 Recreation

Range of Alternatives

Summary

The BLM should consider using seasonal and temporal closures and/or noise regulations to reduce impacts of recreation on GRSG.

Response

During subsequent implementation-level travel management planning, new travel management plans would evaluate vehicle routes and determine the need for permanent or seasonal road closures and mode of travel (e.g., motorcycle, ATV, and UTV) restrictions, including noise levels and speed. Travel management plans would not typically include noise levels. The Proposed LUPA/Final EIS would limit motorized travel to existing routes.

Noise restrictions in the Proposed LUPA/Final EIS are described in **Appendix K**, GRSG Noise Protocols. The impacts of noise on GRSG are analyzed in **Chapters 4** and **5**.

Best Available Information Baseline Data

Summary

The BLM should cite their sources that relate to OHV, recreational facilities, and hunting impacts on GRSG.

The BLM should cite scientific literature related to the impacts of recreation on GRSG, including low-impact recreation (such as hiking and camping).

Response

Recreation use was not identified as a threat by the USFWS in its 2010 Listing Decision. See **Section 4.4.2,** Nature and Types of Effects of the Proposed LUPA/Final EIS, which identifies recreation as having negligible or no impact on GRSG.

Impact Analysis

Summary

The BLM should specify which permits will be allowed and include more than OHV race permits in impact analysis.

Response

The type of Special Recreation Permits (SRPs) that would or would not be approved requires additional site-specific/project-level NEPA analysis and is outside the scope of this document. As described above, the Draft LUPA/EIS provides an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives.

Recreation was not identified as a threat to GRSG in the USFWS 2010 listing determination. As such, very few decisions affecting recreation are being considered in the Proposed LUPA/Final EIS. Given that the BLM and Forest Service are considering few decisions affecting recreation management, the level of analysis required to adequately assess the impacts of those decisions is minimal. Those decisions that would impact recreation, such as restrictions on SRPs, are analyzed in **Section 4.11** of the Proposed LUPA/Final EIS.

Cumulative Impact Analysis

Summary

The BLM should address the issue of hunting of GRSG. The BLM should consider trailheads where existing roads are closed and converted to non-motorized trails.

Response

As described in **Section 1.5.2** of the Proposed LUPA/Final EIS, the Nevada Department of Wildlife and California Department of Fish and Wildlife manage hunting; hunting is not addressed in this planning effort because it is outside the scope of the EIS. Additional information on hunting within the Nevada and Northeastern California Sub-region is also included in **Section 1.5.2**.

The Proposed LUPA/Final EIS includes management (e.g., Proposed Plan Action REC 3) regarding trailheads.

C.2.17 Salable Minerals

Range of Alternatives

Summary

The BLM and Forest Service should implement site-specific criteria related to salable minerals.

The BLM and Forest Service should add existing Nevada Department of Transportation (NDOT) material sources to the state and federal road easements exemption language.

Open pit mines should be prohibited in Alternative D because there is no way to re-establish the pre-existing contours of an open pit mine.

Response

Salable minerals management is a discretionary action for the BLM, and authorizing the sale of permits would be in conformance with the Proposed LUPA/Final EIS and existing regulations. The GRSG screening criteria in Proposed Plan Objective SSS 4 and Actions SSS 1 through SSS 4 would dictate the placement of new mineral material sites in GRSG habitat. Site-specific activities carried out in conformance with this plan, once approved, would be required to result in a net conservation gain for GRSG and its habitat (see **Section 2.6.2** in the Proposed LUPA/Final EIS).

In the Proposed LUPA, all PHMA would be closed to new mineral materials development. Proposed Plan Action SAL 4 addresses access to mineral sites for federal, state, tribal, county, and public needs.

C.2.18 Socioeconomics and Environmental Justice

Best Available Information Baseline Data

Summary

BLM must revise the socioeconomic baseline analysis to include current economic data particularly related to livestock grazing, mining, tax revenues, and unemployment. Certain sectors and existing resources were inaccurately characterized, including geothermal energy development in Churchill County, livestock grazing (generally and for Eureka County and Modoc County, specifically), and mining (Eureka County and Elko County). The relationship between billed and active AUMs is misleading; the BLM needs to better explain the factors that contribute to those differences. The discussion on interest groups and communities of place is confusing and hard to follow. BLM did not reference or evaluate several relevant existing studies (citations provided in comments). BLM did not disclose the revenues generated (to NDOW) from hunting GRSG.

Response

BLM and Forest Service used the best available data at the time the Draft LUPA/EIS was prepared. Most data are from 2010 and provide a snapshot of data at the time. BLM does not expect the difference in impacts across alternatives to be meaningfully altered by updating the baseline. However, the BLM and Forest Service expanded and updated the baseline information for the Proposed LUPA/Final EIS to the extent needed to support an expanded discussion of the geographic distribution of impacts and to more accurately capture long-term trends in employment and economic activity. The BLM and Forest Service also reviewed the data used to characterize economic activity for clarity and adequate description of the geographic areas to which they refer. This included an expanded discussion of billed and active AUMs and the factors determining their different values in **Appendix V** of the Proposed LUPA/Final EIS. The BLM and Forest Service added information related to geothermal development in **Chapter 3** and clarified the mining labor earnings data and adjustments incorporated in this data for place of residence.

BLM and Forest Service reviewed the suggested studies and references put forth by the commenters, and incorporated to the extent that they presented information that would need to be incorporated into the Proposed LUPA/Final EIS. The studies referenced by commenters were incorporated into the analysis for the Proposed LUPA/Final EIS and did not present any new information not previously considered in the Draft LUPA/EIS.

Impact Analysis

Summary

Commenters stated that the economic analysis is overly simplistic and incomplete. Potential losses are portrayed in a much broader context than the environmental impacts. The economic analysis does not evaluate impacts of management common to all alternatives. Alternative A should consider the impacts of a listing. The economic impacts of Alternatives C, D, and E are identical and not different than Alternative A (emphasis on leasable and locatable minerals); this is not consistent with descriptions of management alternatives in Chapter 2. Elko County contains 40 percent of GRSG habitat in Nevada but was not included as one of the greatest impacted counties under Alternative C; how is that possible? Specific studies cited [in Elko County comments] should have been considered and used in the economic analysis. The analysis lacks a meaningful comparison of direct economic and nonmarket value impacts across alternatives. The analysis neglects losses of quality of life.

An explanation of why counties were aggregated for economic analysis is not clear. Focusing on planning area-level impacts and not adequately reviewing effects on individual counties undermines the true impact on the "social structure of local communities and to the economy of the western economy."

Socioeconomic-related comments provided in the context of other program areas are as follows:

Lands and Realty: The cost of reworking transmission line routes is passed onto the customer. The Draft LUPA/EIS "requires new and existing power lines" in PHMA and PPGA to be buried. The result will be increased cost, reduced reliability, and longer outages to Nevada customers. Leaming (2011) is cited regarding impacts on Elko County related to lands and realty management decisions.

Grazing: Economic impacts on livestock grazing were underestimated and the analysis was inadequate and inaccurate (various studies cited). Specific insufficiencies in the analysis include failure to consider the impact of the lack of alternative forage to replace the loss of AUMs; short-term or seasonal restrictions/rest could impact the viability of ranching operations; value per AUM is incorrect; using billed AUMs in the analysis leads to inaccurate results; property value impacts associated with permits were not addressed; economic impacts under Alternative D are understated; and there is a lack of recognition of the interrelationship of public and private grazing.

Recreation: Elko County disputes that recreation activity would be generally unaffected under Alternative D. Elko County requests impacts on recreation be quantified for Alternatives B through F. Economic impacts on OHV use need to be more fully analyzed. Hunting of GRSG generates revenue for the Nevada Department of Wildlife (NDOW) and business for small towns. Road closures can have significant impacts on Nevada Outfitters and Guide Association (NOGA) members' ability to conduct their business and have real economic impacts.

Minerals (general): Socioeconomic analysis of the impacts of withdrawals of lands from mineral development is lacking. "Mining" is omitted from Appendix O of the Draft LUPA/EIS. Costs associated with required design features should be included on a per-acre basis.

Minerals (locatable): Economic impacts analysis under Alternatives B, C, D, E, and F is inadequate and misleading; no quantitative or "even semi-quantitative analysis" was completed. Description of management alternatives reveals "substantial" differences with respect to locatable minerals across alternatives. Draft LUPA/EIS must evaluate the economic impacts on the following entities: individual claim owners, large and small companies that own and develop mining claims, Nevada counties, the State of Nevada, and the US Department of the Interior.

Minerals (leasable): Based on a review of management alternatives associated with leasable minerals, the impact under Alternatives C, D, and E would not be the same under Alternative A. Reasonably Foreseeable Development Scenario is not accurate.

Wind Energy: Quantitative analysis of economic impacts associated with wind energy development needs to be included.

Fire and fuels management: Alternatives B, C, and F will subject residents, communities, and local governments to increased risk of catastrophic fire; removal of livestock grazing would expand fire fuels.

Tax Revenues: BLM needs to analyze the impacts on state and local government tax revenues, particularly in the case of mineral exploration and development. BLM failed to analyze the tax base implications of the potential acquisition of private lands by the federal government under Alternative C.

Environmental Justice: The BLM failed to take a hard look at the impacts on Tribal interests.

Non-Market Value (NMV): Several citations are provided to support the need to analyze NMV of livestock grazing in contrast to BLM's current conclusion that these values are uncertain.

Response

The requisite level of information necessary to provide an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives is to aid in determining whether to proceed with the preferred alternative or to make a reasoned choice among the other alternatives in a manner such that the public could have an understanding of the environmental consequences associated with the alternatives, in accordance with 40 CFR 1502.1. The discussion of environmental consequences should include the proposed action, cumulative impacts, any adverse environmental effects that cannot be avoided should the alternatives be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the proposal should it be implemented (40 CFR 1502.16).

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29; Forest Service Handbook 1909.12 – Land Management Planning). The Draft LUPA/EIS contains only planning actions and does not include any implementation actions. As specific actions that may affect the area come under consideration, the BLM and the Forest Service will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

In response to comments, the BLM and Forest Service revised the impact analysis as follows: a) the analysis of the impacts of management alternatives was revised to ensure that impacts from each management alternative are sufficiently addressed for proper understanding by decision makers and the public and in similar level of detail as the analysis of consequences for other resource areas; b) BLM and Forest Service reviewed the suggested studies and references put forth by the commenters and incorporated them to the extent that they presented information or issues that would need to be included in the Proposed LUPA/Final EIS and that had not previously been considered in the Draft LUPA/EIS; c) BLM and Forest Service expanded the "Summary of Economics Impacts" and "Summary of Social Impacts" in **Section 4.20**. Additional direct comparison of management alternatives is located in **Section 2.12**, Summary of Environmental Consequences; d) BLM and Forest Service expanded the discussion of social impacts to include a broader discussion of potential impacts on the quality of life; and e) additional discussion of impacts on counties was included where possible and appropriate.

In addition, on impacts from management actions affecting: f) lands and realty: a discussion of the potential impacts of power line restrictions on energy ratepayers was included; g) grazing: the impact of management alternatives on AUMs was revised to account for a scenario where closures of seasonally used public lands lead to greater annual losses of AUMs. In addition, an expanded discussion of the potential ranch-level costs as well as social impacts of the loss of public lands for grazing was included; h) recreation: the discussion of the socioeconomics of management alternatives through recreation was revised to ensure that the consequences of differences among management alternatives were appropriately explained; i) minerals: the discussion of the potential socioeconomic impacts of the effects of management alternatives on mining was expanded; j) wind energy: the discussion of the potential socioeconomic impacts of the effects of management alternatives on wind energy was expanded; and k) fire and fuels management: the uncertainty regarding the potential socioeconomic impacts of fire and fuels management is noted.

BLM considers that several aspects commented on are appropriately addressed in the Draft LUPA/EIS at this planning stage. In particular, the treatment of non-market values in this Draft LUPA/EIS is consistent with BLM guidance (see BLM IM 2013-131). Only those non-market values that could reasonably be expected to be meaningfully affected by the choice of management alternatives were discussed. In addition, the environmental justice analysis explicitly discusses interests of Native American tribes and responds to particular concerns as expressed during scoping. Impacts on tax revenues are discussed to the extent possible at this planning stage.

Cumulative Impact Analysis

Summary

There is a lack of a meaningful socioeconomic cumulative analysis related to mining throughout the range of the GRSG in Wyoming, Montana, Idaho, Utah and Nevada that could be affected by various planning efforts. BLM needs to analyze the agencies' ability to fund proposed management under the different alternatives, simultaneously recognizing non-federal funds and resources for GRSG conservation actions. Impacts on non-public lands need to also be considered.

Response

As noted in **Section 5.2.15**, Locatable Minerals, above, due to the variation in types of minerals and occurrence and development potential across the range, and the types of data available for the planning area compared to the entire GRSG range, cumulative impact analysis across the entire GRSG range would not provide meaningful, appropriate analysis. The Draft LUPA/EIS has met the NEPA/CEQ requirements for cumulative impacts analysis in each of the respective sub-regional EISs. Information explaining the rationale behind the chosen geographic extent of the cumulative impact analysis area has been added to **Section 5.14.2**, Locatable Minerals, of the Proposed LUPA/Final EIS.

The cumulative effects analysis prepared for the three WAFWA Management Zones in the Nevada and Northeastern California Sub-region have been included in **Chapter 5** of the Proposed LUPA/Final EIS.

Costs and differences in program costs across alternatives have not been quantified at this landscape-level planning effort, as explained in **Section 4.20**, Socioeconomics and Environmental Justice. Impacts on non-public lands are considered by resource in **Chapter 4** of the Proposed LUPA/Final EIS, to the extent possible.

C.2.19 Soil

Impact Analysis

Summary

Commenters suggested an impact on biological soil crust associated with livestock grazing, which could result in an increase in the amount of cheatgrass.

Response

Additional analysis was added to **Sections 4.5.3** and **4.17.3** of the Proposed LUPA/EIS based on Reisner et al. (2013). However, the new information and analysis does not present a new picture of management or impacts than what was included in the Draft EIS.

C.2.20 Travel Management

Range of Alternatives

Summary

Commenters were divided between additional restrictions on route access, noting that BLM should not close or restrict any access or travel through areas, and suggesting that more routes should be closed through important habitat areas pending BLM's inventory and subsequent travel and transportation analysis.

Commenters also had concerns regarding management actions that would limit new road construction or hinder the ability to maintain existing routes because of the potential of upgrading the route from one category to another.

Commenters were concerned about access for permitted activities, maintenance of infrastructure, and public health and safety.

Response

All alternatives in the Proposed LUPA/Final EIS, with the exception of Alternative A (No Action Alternative), include management actions that limit motorized travel to existing roads and trails in PHMA.

Route selection:

During subsequent implementation-level travel management planning, new travel management plans would evaluate vehicle routes and determine the need for permanent or seasonal road closures and mode of travel (e.g., motorcycle, ATV, and UTV) restrictions, including noise levels and speed. Implementation-level travel management planning will include public involvement.

The route selection process will be completed as subsequent implementation-level planning using current travel management policies and will include public and local agency involvement.

New road construction:

New road construction was addressed in the Draft LUPA/EIS under Action D-LR-W 4: New ROW authorizations would be evaluated on a case-by-case basis.

If new road construction is necessary, minimize impacts on GRSG habitat through application of RDFs and other mitigation measures. Proposed Plan Actions CTTM 4 and CTTM 5 address the construction and upgrading of roads.

Temporary routes would be addressed during implementation-level project evaluation. Temporary routes are generally not constructed during vegetation treatments.

Route Maintenance:

Routine maintenance of a primitive road would not upgrade the classification to a road.

Definitions for "Road," "Primitive Route," and "Trail" were added to the Proposed LUPA/Final EIS.

Roads are linear routes managed for use by low-clearance vehicles having four or more wheels, and are maintained for regular and continuous use.

Primitive roads are linear routes managed for use by four-wheel drive or high-clearance vehicles. They do not normally meet any design standards.

Trails are linear routes managed for human-powered, stock, or OHV forms of transportation or for historical or heritage values. Trails are not generally managed for use by four-wheel drive or high-clearance vehicles.

Permitted Uses:

Needs for administrative access to valid existing rights, grandfathered uses, or permitted activities would be taken into consideration during site-specific NEPA analysis. Restrictions applied to recreational OHV use may not apply to permitted administrative uses.

Best Available Information Baseline Data

Summary

The BLM needs to include an update to **Chapter 3** that indicates which field offices have current travel management plans. Commenters suggested additional studies to be included in the Draft LUPA/EIS, such as Lyon and Anderson 2003 and Blickley and Patricelli 2012.

Response

Chapter 2 contains language stating that lands in the planning area managed by the California BLM, Ely (Nevada) District Office, and Forest Service have current travel planning.

Traffic and acoustic impact comments are from studies related to oil and gas exploration. These impacts would be considered during implementation-level travel planning.

Of the suggested studies and references put forth by the commenters, the BLM and Forest Service reviewed them to determine if they presented new information that would need to be incorporated into the Proposed LUPA/Final EIS, were references already included in the Draft LUPA/EIS, or if the references provided the same information as already used or described in the Draft EIS. The BLM and Forest Service determined that the new information provided by the commenters does not present a significantly different picture that would change the analysis, and/or that the information submitted/used in the Proposed LUPA/Final EIS would not result in analysis that was not previously considered in the Draft LUPA/EIS.

Impact Analysis

Summary

Commenters questioned the scientific accuracy and references that support much of the impact analysis provided on travel management, including specific requests to provide the studies that support analysis statements.

Response

As described above, the Proposed LUPA/Final EIS provides an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives. Further, as described above, the BLM used the most recent and best available information that was relevant to a land use planning-level analysis. Impact analysis included in the Draft LUPA/EIS and Proposed LUPA/Final EIS was prepared in accordance with the BLM Travel and Transportation Handbook H-8342 (BLM 2012) and BLM Manual 1626 (BLM 2011).

Land use plan-level analyses are typically broad and qualitative rather than quantitative or focused on site-specific actions (BLM Land Use Planning Handbook H-1601-1, Chapter II, A-B at 11-13 and Chapter IV, B at 29). The Draft LUPA/EIS contains only planning actions and does not include any implementation actions. A more quantified or detailed and specific analysis would be required only if the scope of the decision included implementation actions. As specific actions that may affect the area come under consideration, the BLM will conduct subsequent NEPA analyses that include site-specific project and implementation-level actions. The site-specific analyses will tier to the plan-level analysis and expand the environmental analysis when more specific information is known. In addition, as required by NEPA, the public will be offered the opportunity to participate in the NEPA process for implementation actions.

The Proposed LUPA/Final EIS includes analysis in **Section 4.12.10**, Travel and Transportation Management, in response to management actions for the Proposed Plan. In addition, the Proposed Plan applies GRSG screening criteria to proposed disturbances in GRSG habitat, requires a three percent disturbance cap on anthropogenic disturbances, and requires the application of RDFs (see **Chapter 2**, **Actions SSS 1 through SSS 4** in the Proposed LUPA/Final EIS).

Mitigation Measures

Summary

The BLM should adopt the invasive species-related prevention/education program found at http://playcleango.org/.

Response

The BLM and Forest Service reviewed the measures provided by commenters on playcleango.org. The measures were found to be similar to those already provided in **Appendix A**, RDFs and BMPs, in the Draft LUPA/EIS (and now provided in **Appendix D**, RDFs of the Proposed LUPA/Final EIS). Results from reviewing the impact analysis confirmed that the outcomes from the suggested mitigation measures would be the same as those described in the Draft LUPA/EIS; therefore, no change is needed.

C.2.21 Tribal Interest

Consultation Requirements

Summary

BLM did not provide sufficient opportunities for tribes to consult or cooperate. BLM did not respond to submitted tribe comments from June 25, 2013.

The Fort McDermitt Paiute and Shoshone Tribe requests a Nation to Nation and Government to Government consultation with the NV-BLM to have meaningful Consultation on matters related to GRSG. The Tribe believes that there will be severe and irreparable environmental impacts from the proposed project and they have significant concerns about the proposed degradation of cultural resources and losses to their living community.

Response

BLM provided tribes the opportunity to comment and participate in the development of the EIS through government-to-government consultation and as a cooperating agency. These efforts were detailed in **Table 3-87** in the Draft LUPA/EIS. Tribal concerns were specifically listed in **Chapter 3** of the Draft LUPA/EIS (**Section 3.18**), to be brought forward in the analysis detailed in **Chapter 4** (**Section 4.17**). For example, the Summit Lake Paiute Tribe noted that access to GRSG strutting grounds during lekking in order to observe behaviors was critical to continuing tribal traditional practices. The Draft LUPA/EIS, therefore, noted that those alternatives that would result in reductions of GRSG numbers could decrease tribal opportunities to observe lekking behavior, and, conversely, those alternatives that would result in maintaining or increasing GRSG numbers would either maintain or increase tribal opportunities to observe lekking behavior. These discussions were completed for each of the alternatives analyzed in the Draft LUPA/EIS (see **Section 4.17**). In addition, the Wildlife section of the Proposed LUPA/Final EIS contains a specific statement that the ROD does not preclude tribal observations of lekking behavior. Tribes that hold grazing permits were concerned that reductions in AUMs could harm tribes economically. **Section 4.17** then noted that no reductions in AUMs were anticipated under Alternatives A, B, D, E, and F, and thus no economic harm to tribes would be anticipated. **Section 4.17** also noted that it was only under Alternative C that AUMs may be reduced, thereby potentially causing economic harm to tribes that hold grazing permits (p. 4-281). All of these discussions have been retained in the Proposed LUPA/Final EIS. Finally, **Table 6-2**, Tribal Consultation and Outreach for the Nevada and Northeastern California Sub-region Greater Sage-Grouse Proposed LUPA/Final EIS, reports the agencies' tribal consultation and outreach efforts since between the release of the Draft LUPA/EIS and the approval of the Proposed LUPA/Final EIS. The Proposed LUPA/Final EIS also includes actions related to tribal interests (see Proposed Plan Actions TI 1 through 3).

The BLM and Forest Service recognize the tribal sovereignty of federally recognized indigenous tribes as well as the laws that clarify the relationship between the federal government and Native American Tribes and the requirement to conduct consultation. The BLM and Forest Service initiated government-to-government consultation with the Fort McDermitt Paiute and Shoshone Tribe in December 2011. In addition, they were invited to participate in the planning effort as a cooperating agency but chose not to sign a formal MOU. Formal government-to-government consultation continued in 2012 with face-to-face meetings with the BLM in June and July and with the Forest Service in June and November of 2013. The BLM and Forest Service are committed to continue formal consultation with all federally recognized Native American Tribes in the GRSG conservation efforts.

During the development of the Proposed LUPA/Final EIS, the Nevada State Historic Preservation Office (SHPO) provided an electronic letter stating that because there are no ground-disturbing activities associated with this planning process, SHPO does not believe there is a need for consultation.

Impact Analysis

Summary

The Draft LUPA/EIS fails to identify, consider, and evaluate the economic development, jobs, and taxes that support local services for the tribe, and how these interests might be impacted. Additionally, the Draft LUPA/EIS should recognize tribal transportation plans, changes in land status, ROWs, and projects approved prior to the Draft LUPA/EIS.

Response

The BLM and Forest Service would not require the ROW grant holder to retro-fit existing power lines until the ROW grant is up for renewal. BLM ROWs are issued on a term basis (10/20/30 year terms). Once the term is up, the BLM may renew the ROW and determine additional terms and conditions based on current policies and guidance (43 CFR 2807).

Withdrawals of federal lands are authorized pursuant to FLPMA and are processed through an application process. Terms established for legislative withdrawals are made at the discretion of Congress.

New road construction is addressed in Action D-LR-W 4: New ROW authorizations would be evaluated on a case-by-case basis. If new road construction is necessary, approval would minimize impacts on GRSG habitat through application of RFDs and other mitigation measures.

The Draft LUPA/EIS stated (**Section 4.17.2**) that many of the "effects on tribal interests are general and unquantifiable in nature." These types of impacts were analyzed in **Section 4.17.3**, where it was noted, for example, that future fluid mineral leasing within PPH/PGH habitats could reduce GRSG numbers and impact tribal observations of lekking behavior. Nevertheless, the alternatives analyzed in the Draft LUPA/EIS were of various levels of complexity. Some alternatives, such as Alternative A, were silent on a number of critical issues, and therefore the impacts of this alternative on tribal interests remains unknown for those issues. In contrast, the preferred alternative, Alternative D, was not silent on a single critical issue analyzed in the Draft LUPA/EIS, and therefore the preferred alternative contained the full suite of analysis on tribal interests. In addition, the Environmental Justice section of the Draft LUPA/EIS specifically details the potential economic impact of each alternative on tribal grazing interests. These analyses have been retained in the Proposed LUPA/Final EIS.

Cumulative Impact Analysis

Summary

Commenter expressed concern about the ability to expand tribal lands for conservation of GRSG and its habitat.

Response

The Proposed Plan Action LR-LT 1 of the Proposed LUPA/Final EIS allows for disposal and acquisition of lands for the conservation of GRSG habitat as long as those actions provide for the net conservation gain to GRSG. Expansion of tribal lands would require Congressional approval and is outside the scope of this analysis.

C.2.22 Vegetation Sagebrush

Range of Alternatives

Summary

Multiple commenters were concerned with vegetation-related issues such as pinion-juniper expansion, sagebrush management, and cheatgrass control. Commenters expressed general concern with the source of information, level of detail, and ability of management actions presented in **Chapter 2** to conserve GRSG habitat.

Commenters also noted that some of the alternatives presented in **Chapter 2** did not adequately address the relationship between vegetation management and livestock grazing management.

Response

The Proposed Plan made some adjustments based on the comments, such as developing new vegetation treatment objectives centered on leks and protection measures for old juniper trees and old-growth juniper stands (**Chapter 2**). Other suggestions are not land management plan decisions. All the relevant actions were considered in the range of alternatives. The Draft LUPA/EIS already included some requests concerning allowable treatment methods, priority juniper phases to treat, and use of native species in restoration efforts in Alternative D; these were carried into the Proposed Plan. Other suggestions were contained in other alternatives in the Draft EIS, such as establishing sagebrush "reserves" (Alternatives C and F) and limiting the use of fire in low-elevation sagebrush (Alternatives B, C, E, and F). Some recommendations are project-level decisions, such as specific locations for vegetation treatments, whether to use prescribed fire, and the length of rest from grazing following treatment. Some suggestions were not feasible or too vague to address. For example, defining "dominance" for invasive plant species depends on the species and ecological site under consideration.

Based on continued coordination between the BLM, Forest Service, and cooperating agencies, the Proposed LUPA incorporates vegetation and GRSG habitat objectives that follow the Sage-Grouse Habitat Assessment Framework Technical Reference-6710-1. In all SFAs and PHMA, the desired condition is to maintain a minimum of 70 percent of lands capable of producing sagebrush with 10 to 30 percent sagebrush canopy cover. The attributes necessary to sustain these habitats are described in Interpreting Indicators of Rangeland Health (BLM Tech Ref 1734-6).

The BLM and Forest Service analyze the relationship between vegetation management and grazing management in the Proposed LUPA/Final EIS based on those actions brought forward for the proposed alternative. The Proposed LUPA/Final EIS also analyzes the effects of proposed livestock grazing on vegetation management. However, specific management actions were not added to the Proposed LUPA/Final EIS to address grazing management as a vegetation management tool.

Best Available Information Baseline Data

Summary

BLM needs to consider additional literature in the Proposed LUPA/Final EIS as a basis for the alternatives and analysis. BLM incorrectly interpreted the literature cited in the Draft LUPA/EIS. BLM needs to provide rationale and sources of information to support the alternatives, affected environment, and impacts analysis within the Proposed LUPA/Final EIS (e.g., for ecological site and reference state concepts, VDDT modeling, and utilization levels).

Response

As described above, the BLM and Forest Service considered the availability of data from all sources, adequacy of existing data, data gaps, and the type of data necessary to support informed management decisions at the land use plan level.

As a result of these actions, the BLM and Forest Service gathered the necessary data essential to make a reasoned choice among the alternatives analyzed in detail in the Draft LUPA/EIS. The BLM and Forest Service used the available data to provide an adequate analysis that led to an adequate disclosure of the potential environmental consequences of the alternatives. For example, the VDDT outputs were added to the Proposed LUPA/Final EIS (see **Appendix M**) and additional analysis supported by Chambers et al. (2014) and the FIAT.

Impact Analysis

Summary

BLM has failed to analyze or has incorrectly analyzed impacts on vegetation in the Draft LUPA/EIS, particularly related to pinyon-juniper expansion, sagebrush management, and cheatgrass control.

BLM needs to substantiate the claim that a reduction in grazing would result in increased fuel loads and increase the frequency of wildfire on the landscape and should evaluate whether it is better to manage for higher levels of vegetation, which would lead to higher fire probability or manage for less canopy spacing to reduce fire start potential.

Response

As described above, the Draft LUPA/EIS provides an adequate discussion of the environmental consequences, including the cumulative impacts, of the presented alternatives. **Chapters 4** and **5** of the Proposed LUPA/Final EIS address VDDT, and a VDDT appendix is included in the Proposed LUPA/Final EIS (see **Appendix M**).

Site-specific analysis of vegetation projects will be conducted at the implementation level and is not part of a planning-level decision.

The Proposed LUPA/Final EIS analyzes, under Alternatives C and F in **Chapter 4**, the effects of reducing livestock grazing on fine-fuel loading and subsequent wildfire risk.

Mitigation Measures

Summary

BLM and Forest Service need to highlight preventative measures to mitigate natural disturbances and increase vegetation resilience and health. The BLM and Forest Service need to provide more detail regarding its vegetation monitoring program. Citations should be provided where necessary to support proposed mitigation measures.

Response

Mitigation and monitoring have been further defined as a Regional Mitigation Framework and National Monitoring Framework, detailed in **Appendix I** and **E**, respectively of the Proposed LUPA/Final EIS. The frameworks are incorporated in the Nevada and Northeastern California GRSG Proposed LUPA/Final EIS and were developed to achieve a net conservation gain to the species by implementing conservation actions. Regional mitigation is a landscape-scale approach to mitigating impacts on resources. This involves anticipating future mitigation needs and strategically identifying mitigation sites and measures that can help achieve the greatest conservation benefit for GRSG and its habitats.

If impacts on GRSG or its habitat from authorized land uses remain after applying avoidance and minimization measures, then compensatory mitigation projects will be used to fully offset impacts to achieve conservation benefits. Any compensatory mitigation will be durable, timely, and in addition to that which would have resulted without the compensatory mitigation. Specific mitigation strategies, based on the framework, will be developed by regional teams within one year of the issuance of the Record of Decision and be consistent with the BLM's Regional Mitigation Manual MS-1794, Forest Service Handbook FSH 1909.15, and CEQ regulations at 40 CFR 1508.20. Mitigation measures for specific projects are implementation-level decisions and will be included in site-specific analysis, which is outside the scope of this EIS.

C.2.23 Vegetation Riparian

Summary

Commenters stated that the BLM and Forest Service should not rely on incomplete Ecological Site Descriptions (ESDs). Also, the BLM and Forest Service should recognize that management needs for riparian areas are often site specific and that a one-size-fits-all approach is not supported by science and in the literature. BLM and Forest Service also need to incorporate principles of adaptive management into livestock grazing strategies for riparian areas.

Response

Although not complete, ESDs are in the process of being developed for riparian areas and wetlands. In 2011, the NRCS issued draft guidelines for lotic areas (NRCS 2011, see discussion of this topic in **Section 4.6.5**, Alternative B, Impacts from Riparian Areas and Wetland Management). Use of ESDs, where available, will result in more site-specific and more appropriate objectives and management actions for riparian habitats. No changes were made to the Proposed LUPA/Final EIS.

Meeting standards for rangeland health can be achieved through a variety of livestock grazing strategies, including use of adaptive management techniques. Adaptive management consists of refinements to the management strategy based on annual analysis of monitoring information relative to short-term events and indicators (Wyman et al. 2006). Where monitoring demonstrates that standards are not being met and livestock are the causal factor, principles of adaptive management provide for adjustments in management strategies where appropriate. Annual indicators of livestock grazing impacts on riparian areas, including measurements of residual vegetation (stubble heights) and/or riparian plant utilization, may indicate a need to employ rest or deferment from grazing. Once progress is being made towards meeting GRSG habitat objectives, adaptive management and/or other site-specific management strategies can continue to be employed. Specific allotment-level adaptive management approaches would be defined at the site-specific level through appropriate NEPA. No changes were made to the Proposed LUPA/Final EIS.

Range of Alternatives

Summary

Commenters stated that the BLM and Forest Service should not use stubble height as a habitat objective in riparian areas and should develop more appropriate riparian management objectives.

Commenters stated that in addition, PFC is an inappropriate measurement of GRSG habitat suitability.

Commenters stated that the BLM and Forest Service must establish widths for riparian management zones. A requirement of a ½-mile buffer around riparian areas and leks for livestock supplements and handling facilities is inadequate to protect GRSG.

Commenters stated that Draft LUPA/EIS should establish a timeframe for meeting goals and objectives for riparian areas.

Commenters stated that the BLM and Forest Service do not provide statistics for condition of riparian areas.

Response

Where monitoring demonstrates vegetation objectives are not being met and livestock are the causal factor, a range of management options provide for adjustments in management strategies where appropriate. In terms of applicability of stubble height requirements to various site conditions, consideration is provided for "site capability and potential." Application of stubble height criteria occurs at the implementation level and considers site-specific conditions.

The Proper Functioning Condition (PFC) assessment protocol addresses the basic processes that sustain water tables and riparian plant communities. If a riparian area is not functioning properly, then it is likely the biological processes, such as creation of suitable habitat, will be impaired. The PFC protocol is designed to help establish and prioritize management, monitoring, and restoration activities and to provide a focused and effective foundation for determining resource goals and identified resource values (Prichard et al. 1998, Dickard et al. 2014). Use of this process optimizes management of GRSG habitat through a sequential set of steps, which include: determination of resource values; development and prioritization of goals and actions; collection of baseline data and establishment or modification of objectives; implementation of planned actions and effectiveness monitoring, including updating PFC status; and implementation of adaptive management actions (Dickard et al. 2014). No changes have been made to the Proposed LUPA/Final EIS.

Brood-rearing habitat objectives are identified and have been clarified in **Table 2-2** (formerly Table 2-6 in the Draft LUPA/EIS). An updated version of the table is included in the Proposed LUPA/Final EIS.

Management actions in the Proposed Plan are designed to meet riparian vegetation objectives. The timeframe within which those objectives are met is dependent on a number of variables, such as funding and weather/climate conditions (e.g., drought or flood).

All available data for condition of riparian areas across the planning area are summarized in **Table 3-12 of the Proposed LUPA/ Final EIS**. These data, which include riparian acreages, miles of stream, and number of assessments, are expressed as expressed as percent of lotic and lentic riparian areas meeting goals. Refer to **Section 3.4**, Riparian Areas and Wetlands, of the Proposed LUPA/Final EIS for a discussion of these findings.

Best Available Information Baseline Data

Summary

The BLM and Forest Service provided insufficient sources regarding riparian baseline information.

Response

Comprehensive PFC data are not available on a sub-regional level but are displayed where available.

Impact Analysis

Summary

Commenters asserted that the BLM and Forest Service relied on incorrect assumptions, especially in regards to fluid mineral leasing, when conducting the impact analysis on grazing and riparian area management. The LUP requirements for avoiding disturbance within 400 feet of riparian areas or water ways should provide adequate protection of riparian habitats. The BLM and Forest Service provided no basis for the conclusions in the Draft LUPA/EIS and need to quantify impacts on riparian areas.

The BLM and Forest Service should incorporate additional literature to improve the impact analysis in the Draft LUPA/EIS.

Response

Potential impacts on riparian areas and wetlands as a result of oil and gas exploration and/or development are typically project specific. Measures to mitigate or reduce identified impacts depend on feasibility and can vary by area or by project. Although avoidance of disturbance within 400 feet of riparian areas is referenced in BLM 1987a and BLM 2005e, these documents provide general guidance for consideration of riparian and wetland habitats as a result of activities associated with leasable minerals management. Depending on the project, it is not always practical or possible to avoid disturbance to riparian areas. For example, it is often necessary to cross drainages with access roads or with the actual pipeline itself. A discussion of potential impacts that have been identified through recently completed environmental analyses for oil and gas projects within the planning area has been added to the Proposed LUPA/Final EIS in **Section 4.6.2**.

Based on the kinds of potential impacts identified for recent projects in the planning area and on the fact that disturbance to riparian areas can always be avoided or mitigated, we assume that impacts will be less for alternatives that close more acres to fluid minerals leasing in comparison to Alternative A.

Additional literature has been reviewed and additional references and corresponding analysis incorporated into the Proposed LUPA/Final EIS.

C.2.24 Water

Summary

Commenters stated that the BLM must comply with Nevada Water Rights and the plan should not threaten private water rights.

Response

The Proposed LUPA/Final EIS includes discussion of how the protection of GRSG will comply with state water law and continue to recognize valid existing water rights. See **Section 2.3** of this comment report for a more detailed explanation of the Draft LUPA/EIS's compliance with FLPMA and other local, state, and federal plans and policies.

Best Available Information Baseline Data

Summary

Commenters stated that the Proposed LUPA/Final EIS should include the number of miles of 303(d)-listed streams located within PHMA and the miles/acres not supporting the Propagation of Wildlife beneficial use water quality standard.

Response

There is no definition of what water quality measures are used to determine if a water is meeting the beneficial use for propagation of wildlife, and it is difficult to determine which specific water quality constituents could impact GRSG. The database for 303(d)-listed water bodies identifies the threats (water quality impacts) to the primary beneficial use of that water body. If wildlife is a secondary beneficial use, the dataset would not identify the specific water body. Thus, a query of streams that are not meeting water quality standards that have a beneficial use to wildlife could underrepresent the extent of the impact on GRSG.

Impact Analysis

Summary

Commenters stated that the BLM needs to better analyze impacts on water resources from minerals management.

Response

The Proposed LUPA/Final EIS has been revised to:

- Include additional analysis under Alternative C
- Clarify confusing language under Alternative E
- Revise the Alternative F impact analysis from mineral resources on water resources section in **Chapter 4**

- Include additional analysis related to impacts on water resources from Wild Horses and Burros and Fluid Minerals in **Chapter 4**

Cumulative Impact Analysis

Summary

Commenters requested that the BLM and Forest Service clarify how the plan will integrate existing drought management guidelines and requirements.

Response

The Proposed LUPA/Final EIS is consistent with the BLM Nevada Drought Management Handbook and national policy related to drought management. For added clarification, a definition of drought has been added to the Proposed LUPA/Final EIS glossary.

C.2.25 Wild Horse and Burros

Summary

Commenters stated that the Draft LUPA/EIS failed to comply with the FLPMA and WFRHBA by restricting wild horses. Commenters also stated that the preferred alternative would give the BLM too much discretion to reduce AMLs or zero out HMAs, which would violate the BLM's legal mandate to protect WHB. One commenter stated that "Table 2.1 appears to suggest that feral horse and burro are not subject to reductions in population."

The majority of the commenters stated that grouping livestock and wild horses and burros together in the plan and the equal reduction in forage under the alternatives was not appropriate based on the fact that only 12 percent of the GRSG habitat overlapped with HMAs.

Commenters also identified that passages from the WFRHBA were misquoted or edited not to reflect the intent of the act and requested revision to the text.

Response

The BLM protects, manages, and controls wild horses in accordance with the Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971 (Public Law 92-195, as amended), the purpose of which is to "manage wild horses and burros within herd management areas (HMAs) designated for their long-term maintenance, in a manner designed to achieve and maintain a thriving natural ecological balance (TNEB) and multiple use relationships." The FLPMA directs the BLM to manage wild horses and burros as one of numerous multiple uses and sustained yield, including mining, recreation, domestic grazing, and fish and wildlife. It also required a current inventory of wild horses and burros. Additional guidance is found in 43 CFR 4700, Protection, Management, and Control of Wild Free-roaming Horses and Burros. The BLM does not manage for feral horses and burros.

Adjusting AML does fall within the legal mandate of the BLM to protect WHB. Through the BLM's program of monitoring and analysis of data, AMLs have been established and will continue to be adjusted based on the analysis of data and the achievement of management goals and objectives, including rangeland health standards and GRSG habitat objectives. AMLs can be adjusted based on the limitations and capability of the range, including the four habitat components (cover, water, space, and forage), while managing for healthy populations of WHBs in balance with other uses and resources (including GRSG).

Proposed management actions for livestock are separate from those for wild horse and burros (see **Table 2.4**, Description of Alternative Goals and Objectives in the Draft LUPA/EIS and **Table 2-14**, Description of Alternative Goals and Objectives, in the Proposed LUPA/Final EIS). The proposed reduction of AUMS for both domestic livestock and wild horses and burros under Alternative C would increase the potential to achieve the necessary and targeted GRSG habitat management goals to the benefit of GRSG and other native wildlife species. Reducing overall AUM allocations (permitted use for livestock and AMLs for wild horses and burros) would reduce the level of competition and utilization on key perennial grasses, which should allow increased residual plant material for improved nesting and protective cover while increasing overall vegetative health.

The relevant WFRHBA text has been revised in the Proposed LUPA/Final EIS as appropriate.

Best Available Information Baseline Data

Summary

Commenters stated that there was insufficient discussion in **Chapter 3** of the Draft LUPA/EIS of the impacts of wild horses and burros on rangeland health and that the Draft LUPA/EIS failed to provide data that demonstrates the different impacts of wild horse and burros and domestic livestock on rangeland health.

Commenters were also concerned that the National Academy of Sciences' 2013 recommendations for reform of federal wild horse management program were not used in this Draft LUPA/EIS.

Comments also identified an error within the **Chapter 3** WHB map and questioned the sources of data used in the Draft LUPA/EIS.

Response

Discussion of the impacts on wild horses and burros is included in **Section 4.8** of the Proposed LUPA/Final EIS. Discussion of the influence of wild horses and burros on rangeland health is included in **Chapter 3**, Vegetation of the Draft LUPA/EIS.

The National Academy of Sciences report has been considered in the development of the Proposed LUPA/Final EIS, and actions appropriate to the land management planning level are included. Findings of the National Academy of Sciences would also be considered during site-specific NEPA actions.

Regarding the specific comment that identified that there were errors within the **Chapter 3** wild horse and burro map, the map has been thoroughly reviewed and the area covered by the identified Townships and Ranges are actually within the New Year's Lake Historic HA administered by the California BLM. The BLM has reviewed citations in the Draft LUPA/EIS and revised them as appropriate for the Proposed LUPA/Final EIS.

Impact Analysis

Summary

Commenters stated that the BLM failed to analyze the impacts of reductions in forage allocations on wild horses and burros.

Commenters were also concerned that the analysis of impacts on GRSG from wild horses and burros was not distinguished from livestock, which inaccurately skews the impacts.

Commenters also identified contradictions in the document such as where the document states that "Under all alternatives, no direct change would occur to areas allocated as HMAs/WHBTs for wild horses and burros," and then the report proceeds to summarize how parts of alternative would restrict wild horse and burro usage in their own federally designated habitats.

Response

Reductions in AMLs are analyzed in **Section 4.8** of the Proposed LUPA/Final EIS. Definitions for AMLs and AUMs are included in **Chapter 8** of the Proposed LUPA/Final EIS.

The USFWS identified grazing as a threat in the NTT and COT report but did not specifically delineate between livestock and wild horse and burro grazing. However, in the development of the Draft LUPA/EIS, BLM did analyze impacts on wild horse and burro and domestic livestock grazing separately and also analyzed the impacts on GRSG from wild horse and burro and domestic livestock grazing separately. Impacts on GRSG from wild horse and burro and domestic livestock grazing are identified in **Section 4.3** of the Draft LUPA/EIS. Impacts on wild horses and burros from GSRG management strategies are identified in **Section 4.7** of the Draft LUPA/EIS.

Text in the wild horse and burro impact section has been reviewed and the relationship between allocation and management actions clarified in the Proposed LUPA/Final EIS, **Section 4.8**.

Under Alternative F, in contrast, AMLs would be directly reduced by 25 percent for all HMAs within PHMA and GHMA. This would result in a reduction of the established AMLs for all HMAs that are located entirely or partially within mapped occupied GRSG habitat. As a result of AML reduction under Alternative F, costs of wild horse and burro management would increase, due to a need for additional horse gathers for removal and/or population growth suppression (PGS) treatments.

C.2.26 Wilderness Areas/Wilderness Study Areas

Summary

The implementation of Secretary Salazar's Secretarial Order No. 3310, Section 5(d) and compliance with BLM's Manuals 6310 and 6320 will conflict with the Department of the Interior, Environment and Related Agencies Appropriations Act of 2014.

Response

Secretarial Order 3310 (issued in December of 2010) was never implemented, as the Department of Defense and Full-Year Continuing Appropriations Act of 2011 (PL112-10) prohibited the use of funds to implement the Secretarial Order during fiscal year 2011. The primary direction under Secretarial Order 3310 was the designation of "Wild Lands" that were to be derived from wilderness characteristics inventories. Since that time, BLM has provided additional policy in 2012 in the form of Manuals 6310 and 6320, which excludes any designation of "Wild Lands" but continues to provide direction for the inventory of public lands for wilderness resources under FLPMA Sections 201 and 202, which is considered appropriate under the Appropriations Act of 2014.

However, this is a land use plan amendment related to GRSG; therefore, consideration of wilderness characteristic management actions is outside the scope of this planning process and is not carried forward for detailed analysis in the Proposed LUPA/Final EIS.

Range of Alternatives

Summary

BLM wilderness management plans and the establishment of lands with wilderness characteristics through Manual 6320 in current and future land use plan revisions should be considered as a means to provide protection for the GRSG and habitat.

Response

The management of lands with wilderness characteristics is outside the scope of this planning effort. This plan does not make any decisions regarding the management of lands for protection of wilderness characteristics; however, there may be beneficial impacts to managing lands with wilderness characteristics for purpose of GRSG conservation (see **Section 4.16** in the Proposed LUPA/Final EIS).

Wilderness management plans provide general guidance in the management of the designated area through compliance with the Wilderness Act and policies provided in BLM Manual 6340–Management of Designated Wilderness. Direction for the management of Threatened and Endangered Species and Restoration–Vegetation Management is provided in Manual 6340; it is Wilderness Act policy on wilderness that the wilderness resource is the priority. Other resource actions are subordinate to the preservation of wilderness, and any actions proposed for other resources such as threatened and endangered species can be conducted but at levels minimal enough to preserve the threatened and endangered species but with minimal impact on wilderness characteristics.

BLM is required by policy through Manual 6320 to consider lands with wilderness characteristics for the management and protection/preservation of those characteristics during a land use plan revision. However, this is a land use plan amendment related to GRSG; therefore, consideration of wilderness characteristic management actions is outside the scope of this planning process and is not carried forward for detailed analysis in the Proposed LUPA/Final EIS. These lands are considered for the wilderness characteristics that they contain, as well as size, naturalness, outstanding opportunities for solitude, and/or outstanding opportunities for primitive unconfined recreation. Threatened/ endangered or sensitive plant/animal species are not wilderness characteristics; rather, they are supplemental values that are not necessary for the determination of wilderness character. The decision to manage or not manage the wilderness characteristics in any lands with wilderness character area is based upon analysis of all resource use needs and public benefits.

Best Available Information Baseline Data

Summary

All lands with wilderness characteristics that overlap with GRSG habitat represent good opportunities for GRSG conservation and should be analyzed to see how managing those lands to protect wilderness characteristics would coincide with GRSG conservation.

The Draft LUPA/EIS needs to consider management of lands with wilderness characteristics in the scope of this process and needs to discuss ongoing lands with wilderness characteristics inventories and any potential conflict with the implementation of Secretarial Order 3310.

Response

The focus of management of wilderness characteristics is upon the protection/preservation of wilderness characteristics: size, naturalness, outstanding opportunities for solitude, and/or outstanding opportunities for primitive unconfined recreation. The preservation of GRSG habitat within lands with wilderness characteristics would be a secondary benefit, not the primary benefit of any decision to manage wilderness characteristics. Management decisions on activities within lands with wilderness characteristics are not as stringent as those for WSAs or designated wilderness.

The primary direction under Secretarial Order 3310 was the designation of "Wild Lands" that were to be derived from wilderness characteristics inventories. BLM Manuals 6310 and 6320 excludes any designation of "Wild Lands" but continues to provide direction for the inventory of public lands for wilderness resources under FLPMA Sections 201 and 202, which is considered appropriate under the Appropriations Act of 2014.

Impact Analysis

Summary

Commenters requested clarification regarding how the BLM adapts wilderness management plans to provide opportunities to protect and increase GRSG habitat where vegetation treatments are limited or disallowed.

Response

Wilderness management plans provide general guidance in the management of the designated area through compliance with the Wilderness Act and policies provided in BLM Manual 6340–Management of Designated Wilderness.

Direction for the management of Threatened and Endangered Species and Restoration–Vegetation Management is provided in Manual 6340; it is Wilderness Act policy on wilderness that the wilderness resource is the priority. Other resource actions are subordinate to the preservation of wilderness, and any actions proposed for other resources such as threatened and endangered species can be conducted but at minimum levels (enough to preserve the threatened and endangered species but with minimal impact on wilderness characteristics). However, this is a land use plan amendment related to GRSG; therefore, consideration of wilderness characteristic management actions is outside the scope of this planning process and is not carried forward for detailed analysis in the Proposed LUPA/Final EIS.

C.2.27 Predation

Summary

Commenters stated that the BLM and Forest Service failed to consider the threat of predation on GRSG or needed to consider additional information about predation on GRSG.

Response

In the USFWS 2010 Listing Decision (75 *Federal Register* 13910), the USFWS stated "Based on the best scientific and commercial information available, we conclude that predation is not a significant threat to the species such that the species requires listing under the Act as threatened or endangered." The USFWS acknowledged that increasing patterns of landscape fragmentation are likely contributing to increased predation on the species and identified two locations where predators may be limiting GRSG populations because of intense habitat alteration and fragmentation. One of the two locations identified is within the Nevada and Northeastern Sub-region in Northeastern Nevada.

As stated in **Sections 1.5**, **3.5**, and **4.3** of the Draft LUPA/EIS, adding management actions specifically to remove predators is outside the scope of this amendment. However, the BLM has authority to manage the habitat and has provided numerous management actions to address predation risk across the range of alternatives. Additional management goals, objectives, and actions as well as RDFs were added to the Proposed Plan (see for example, Proposed Plan Objective PR 1 and Actions PR 1 through PR 4).

C.2.28 Noise

Summary

Commenters refute the Patricelli study used to determine that low-frequency mining noise does not diminish as it traveled away from its source.

Other commenters state that BLM needs to consider the Patricelli et al. study that suggests new dB(A) levels for interim protections. The BLM also needs to include additional information in **Chapter 3** regarding the relationship between the ambient sound environment and life-cycle requirements for nesting, breeding, and avoiding predation.

Response

The BLM and the Forest Service complied with CEQ regulations in describing the affected environment. Changes in the Proposed LUPA/Final EIS to the Amstrup and Phillips (1977) research were made in **Chapter 4** under Locatable, Leasable, and Salable Minerals Management. The following literature was also added to the noise discussion in **Chapter 4**:

- Blickley, J. L., Blackwood, and G. L. Patricelli. 2012a. Experimental Evidence for the effects of chronic anthropogenic noise on abundance of GRSG at leks. *Conservation Biology* 26:461-471.
- Blickley, J. L., K. R. Word, A. H. Krakauer, J. L. Phillips, S. N. Sells, J. C. Wingfield, and G. L. Patricelli. 2012b. Experimental chronic noise exposure is related to elevated fecal corticosteroid metabolites in lekking male GRSG (*Centrocercus urophasianus*). Plos ONE 7:e50462.

C.3 Commenter List

Abdalla, Abdelmoez
Allan, Dave
Allan, Susan
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Amador, Don
Bailey, George
Ballard, Scott
Ballard, Thad
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Barnett, Cindy
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Bartell, Edward
Bartell, Robert
Baughman, Mike
Bear, Allie
Beattie, Jane
Beeson, C. Dwight
Benes, Michelle
Bengochea, Gary L.
Benson, Robert and Sandra
Betes, Melissa
Black, Beth
Black, William D
Blackburn, Gary
Blanchard, DA
Bloyed, Darin
Bodker, Greg
Boeger, Karen
Boies, Steve and Robin
Boles, Steve
Bradford, Bang
Branscomb, Bruce
Brasher, DeEllen
Brennan, Michael
Brennan-Petitt, Maureen
Brinkerhoff, Stacey
Brown, Elaine
Bruinsma, Richard
Bryan, Dennis
Buell, Jim
Bullock, Dean

Bunch, Beth

Bunquet, Wanda

Bunyard, John and Susie

Buzzetti , Rachel

Buzzetti, Mitch

Byrne, Michael

C/O Budd-Falen Law, Joe Hemphill

Cain, Alan

Caine, Alan

Calabrese, Renato

Calkins, Lawrence

Carey Cockrell, Debra Anne

Carey, Carolyn

Carver, James

Casey, Marvin & Edie

Cavallo, Janet

Clark, Catherine

Clark, Christopher W.

Clark, Randy and Cindy

Cleveland, Gaylord

Cockrell, Will & Debra

Collins, Susan

Conley, Ken

Connelley, James E.

Conner, Teresa T.

Connor, Michael J.

Coombs, Duane

Courtney, Willey

Cowan, William

Creechley, Dot

Crowley, Tim

Culver, Nada

Curtis, Sean

Dahl, Jonathan

Dahl, M. Jonathan

Dalton, Brad

Danser, D. A.

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Davis, Russ

DeForest, Kathleen

Deist, Bill

Delia Scholes, Edward Newbold

DeMulder, Dave

Depaoli, Ed

Depaoli, Edwin

DeSoto, Randi

Diebold, Tony

Dietrich, Katharine

Drozdoff, Leo

Duerr, Naomi and Herb

Dufurrena, Linda

Dupree, Gale

Dutson, Richard

Eckstein, Ron and Jan

Elder, Joel W.

Elkins, Rebecca

Ellis, Mark G.

Ellison, John

Ellison, Peter K.

Erquiaga, Carl

Erquiaga, Gene & Wynarda

Espil, Brent

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Falen, John

Ferrigan, James J.

Fitch, Clay R.

Fite, Katie

Foiles, Lauren

Fontaine, Jeff

Frank-Churchill, Maurice

Frey, Leon

Frisby, Bradford V.

Fulstone, Fred

Gardner, Cliff

Garrett, Jennifer

Gatzke, James

Gerber, A. Grant

Gerber, Travis W.

Gerber, Zachary

Giesinger, Chad

Goicoechea, J. J.

Goicoechea, Julian

Gooch, Scott R.

Gottschalk, Michael and Marian

Gourley, Kathy

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Gracian

Granier, Laura

Gregg, Kathleen

Gregory, Lynn

Gustavson, Donald G.

Hadder, John

Hagge, William

Hall, Keith

Hall, Steve B.

Hansen, Keith
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Harison, Josh
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Hartley, Dale and Michelle
Hartman, Stephen D.
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Hemphill, Craig
Henderson, Don
Hennessy, Eileen
Heston, Gerald S.
Heverly, Debra
Higbe, Ed
Hill, John
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Hooper, Scott
Hubbell, Richard
Hummel, Mel
Jackson, John C.
Jaksick, Todd
James, Hank
Jeffries, Michael C.
Jellison, Cary
Johnson, Larry
Johnson, Redge
Johnson, Rodney
Johnson, Teri
Jones, Chuck
Juetten, Susan
Kaleta, Donald and Dolores
Keesey, Tim
Kennedy, Eric C.
Kircher, Joe and Paula
Kline, Diana
Koch, Edward D.
Koehler, Steven
Krenka, Henry
Kresge, Jerry
Kryder, Levi
Kula, Chris
La Bate, Ron
La Point, Peggy
Labrum, Richard
Lampros, John
Landstom, Katherine
Langsdorf, Michelle
Lanier, Rhonda
Lassiter, Debbie
Lee, Kevin & Amy
Leinassar, Marianne
Lightsoot, Art
Liguori, Sherry
Lister, Bevan
Little, David & Bonnie
Lockard, Brian
Lockwood, Eleanor
Lowry, Daniel
Luttrell, David
Lutz, Wendi
Lynch, Janet
Lynne, Marjorie
Lytle, Ken
Mach, Craig
Maher, Steve and Amorita
Malone, Patrick
Manji, Neil
Marshall, Zane L.
Martin, Walter
Martyn Goforth, Kathleen
McClerkin, Johnny and Dawn
McClintick, Cris
McGarva, Jared
McNeill, H. G.
Mertens, Jeannie
Michelle and Sophie
Miller, Marilyn
Molvar, Erik
Montero, Leonard
Mori, Sam
Morrison , Lanny
Morrison, Isaac
Moseley, Claire M.
Mosley, John
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Myers, Charlie L.
Nappe, Tina
Naveran, Jim and Raylene
Neff, David
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Nelson, Richard
Nelson, Stephen C.
Netherton, Sharon
Niendorf, John
O’Connor, Carita
Oldfield, Justin

Oster, Sherry
Owens-DeMulder, BJ
Papez, Luke C.
Paris, Mark
Paris, Rama
Parks, Buck
Parks, Jerry
Patrice, Gordon
Pauley, Trish
Phillips, Bill
Powell, Randy
Ranf, Dan
Rankin, Wayne
Ratliff, Chris
Redd, Robert
Redfern, Richard
Reed, Nancy
Reinhart, Kimberly
Renner, Ira
Reynolds, Ann
Reynolds, Ray
Rhoads, Sharon
Rodriguez, Shammy
Rogers, James
Rogers, Patrick C.
Rookstool, Brian
Rovner, Jeffrey
Rowley, Randy
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Salvo, Mark
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Schlup, Marci L.
Schultz, Brad
Schweigert, Robert N.
Seal, Jette
Seal, Thom
Seddon, Klara
Sendelbach, Barbara
Shaddrick, David
Shaw, Chris
Shirley, Jim
Sicking, Joe
Simkins, Connie
Skaer, Laura
Slough, S. Wallace
Smart, Tildon
Smell, Cara
Smith, Byron
Smith, Clay
Smith, Gerald
Smith, Julian C.
Smith, K. K.
Smith, Randy
Snyder, Kyle
Southern, Thomas L.
Spates, Georgeanne
Spear, Nelson
Spivak, Randi
Spratling, Boyd
St. Clair, Rondey and Virginia
St. Louis, Robert
Steitz, Jim
Steve, Central
Stevenson, Ronald
Stewart, John
Stix, David
Stockham, Arlo
Stovall, Judy
Strickland, Rose
Struhsacker, Debra W.
Swanson, Sherman
Sweeney, Mike
Taschereau, Linda
Taylor, Duane
Taylor, James
Theriault, Brion
Thomlinson, John
Thompson, Warren
Thorne, Sara
Tingey, Orson
Tomera, Kevin
Tomera, Paula
Tomera, Pete
Torell, Ron
Tueller, Paul T.
Tuma, Matthew
Uhalde, Brookyn, Alex, Jessica, & Leslie
Ure, Therese A.
Van Horn, Valerie
Van Kleeck, Kathy
Venturacci, Randy
Vesco, Vanse
Vincent, Renee
Vitrano, Paul

Volker, Stephan C.
Wadsworth, Charmane
Waldock, Elizabeth
Watkins, Kathleen
Whipple, Chuck
Whitaker, Randall
White, Jeff
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Wilkinson, Fred
Wilkinson, Judy
Williams, Jean
Williams, Marta
Williams, Richard
Williams, Tom
Wills, James S.
Wilson, April Marie
Wilson, Bill
Wilson, Dennis R.
Wilson, Gary
Wilson, Jeffrey
Wilson, Walter
Wines, Buster
Winrod, Jay C.
Witherspoon, Tony
Wolf, Wylin and Lili
Wood, Ramsey
Woollums, Cathy S.
Wosick, Larry
Wright, Jay
Young, Christopher E.
Youngberg, Lyman
Younkin, Brenda
Zimmerman, John R.
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Zocco, Rachelle

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Appendix G
Fire and Invasives Assessment Tool

APPENDIX G
FIRE AND INVASIVES ASSESSMENT TOOL

In the Great Basin Region (WAFWA Management Zones III, IV, and V), the US Fish and Wildlife Service (2013) identified wildfire as a primary threat to Greater Sage-Grouse (GRSG) and its habitat. In particular, it identified wildfire in response to invasive annual grasses and conifer expansion. The Fire and Invasives Assessment Tool (FIAT) provides the BLM and other land management agencies with a framework for prioritizing wildfire management and GRSG habitat conservation.

Supported by US Forest Service General Technical Report 326 (Chambers et. al. 2014; see **Attachment 1**), FIAT provides the BLM and other agencies with a mechanism to identify and prioritize areas within GRSG habitat for potential treatment based on their resistance and resilience characteristics. In the cold desert ecosystem typical throughout the Great Basin, soil moisture and temperature fundamentally influence a landscape's ability to resist environmental change. These factors also influence the landscape's ability to be resilient after long-term ecosystem shifts following a disturbance event, such as wildfire. Low resistance and resilient landscapes are typically characterized by low elevations, south-facing slopes, and porous soils. These areas will likely respond differently to fuels management, wildfire, and subsequent rehabilitation compared to more resistant and resilient landscapes, such as those at higher elevations or on north-facing slopes.

At the resource management planning level, FIAT consists of the following parts:

- The identification of areas at the landscape level, based on national datasets and scientific literature, where the threat to GRSG and its habitat from conifer expansion and wildfire/invasive annual grass is highest
- The identification of regional and local areas where focused wildfire and habitat management is critical to GRSG conservation efforts
- The identification of overarching management strategies for conifer expansion and invasive annual grasses in the areas of habitat recovery/restoration, fuels management, fire operations, and post-fire rehabilitation/emergency stabilization and rehabilitation (ESR)

Attachment 2 outlines the FIAT landscape-level framework and describes the anticipated process for implementing the resource management strategies in the BLM district office and National Forest Unit. Ultimately, the outcomes of the FIAT process will provide land managers with spatially defined priorities and management protocols for the following:

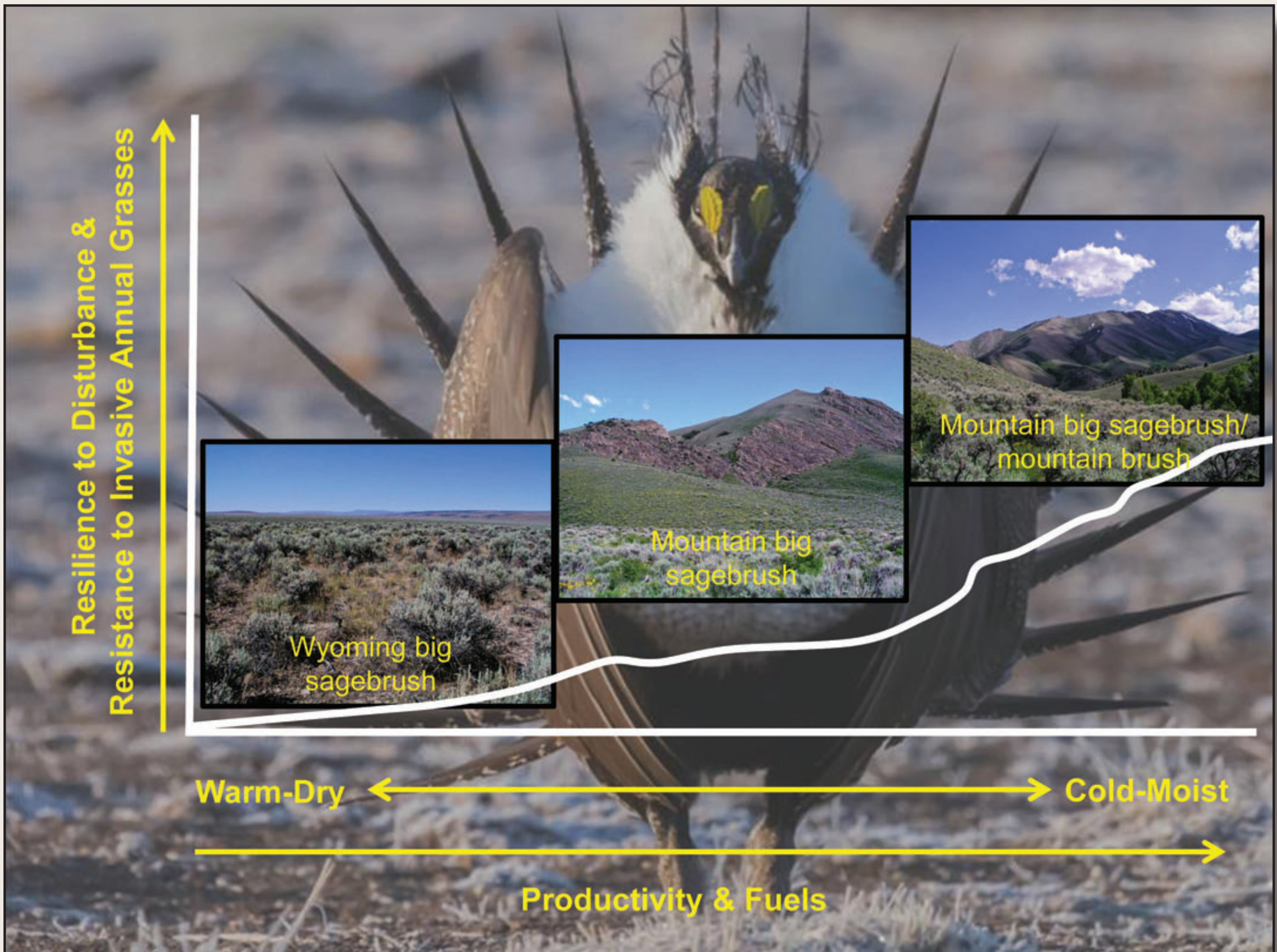
- Operational decision-making during fires
- Implementation of NEPA projects for invasive annual grass and conifer reduction, fuel breaks, and ESR efforts in GRSG habitat

Attachment 1—Chambers et al. 2014 report
Attachment 2—Greater Sage-Grouse Wildfire, Invasive Annual Grasses, and Conifer Expansion Assessment

USDA
United States Department of Agriculture

Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

Jeanne C. Chambers, David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S. Boyd, Steven B. Campbell, Shawn Espinosa, Douglas W. Havlina, Kenneth E. Mayer, and Amarina Wuenschel



Forest Service | Rocky Mountain Research Station | General Technical Report RMRS-GTR-326 | September 2014

Chambers, Jeanne C.; Pyke, David A.; Maestas, Jeremy D.; Pellant, Mike; Boyd, Chad S.; Campbell, Steven B.; Espinosa, Shawn; Havlina, Douglas W.; Mayer, Kenneth E.; Wuenschel, Amarina. 2014. **Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: A strategic multi-scale approach**. Gen. Tech. Rep. RMRS-GTR-326. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 73 p.

Abstract

This Report provides a strategic approach for conservation of sagebrush ecosystems and Greater Sage-Grouse (sage-grouse) that focuses specifically on habitat threats caused by invasive annual grasses and altered fire regimes. It uses information on factors that influence (1) sagebrush ecosystem resilience to disturbance and resistance to invasive annual grasses and (2) distribution, relative abundance, and persistence of sage-grouse populations to develop management strategies at both landscape and site scales. A sage-grouse habitat matrix links relative resilience and resistance of sagebrush ecosystems with sage-grouse habitat requirements for landscape cover of sagebrush to help decision makers assess risks and determine appropriate management strategies at landscape scales. Focal areas for management are assessed by overlaying matrix components with sage-grouse Priority Areas for Conservation (PACs), breeding bird densities, and specific habitat threats. Decision tools are discussed for determining the suitability of focal areas for treatment and the most appropriate management treatments.

Keywords: sagebrush habitat, Greater Sage-Grouse, fire effects, invasive annual grasses, management prioritization, conservation, prevention, restoration

Cover photos: *Greater Sage-grouse photo by Rick McEwan; sagebrush habitat photos by Jeanne Chambers.*

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Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on the Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach

Jeanne C. Chambers, David A. Pyke, Jeremy D. Maestas, Mike Pellant, Chad S. Boyd, Steven B. Campbell, Shawn Espinosa, Douglas W. Havlina, Kenneth E. Mayer, and Amarina Wuenschel

Introduction

An unprecedented conservation effort is underway across 11 States in the western United States to reduce threats to Greater Sage-Grouse (*Centrocercus urophasianus*; hereafter, sage-grouse) and the sagebrush ecosystems on which they depend (fig. 1). Recent efforts were accelerated by the March 2010 determination that sage-grouse warrant protection under the Federal Endangered Species Act, and by increased emphasis on broad collaboration among state and Federal partners to proactively identify and implement actions to reverse current trends (USFWS 2010, 2013). Conservation success hinges on being able to achieve "the long-term conservation of sage-grouse and healthy sagebrush shrub and native perennial grass and forb communities by maintaining viable, connected, and well-distributed populations and habitats across their range, through threat amelioration, conservation of key habitats, and restoration activities" (USFWS 2013). While strides are being made to curtail a host of threats across the range, habitat loss and fragmentation due to wildfire and invasive plants remain persistent challenges to

Figure 1. Greater Sage-Grouse (*Centrocercus urophasianus*) (photo by Charlotte Ganskopp).

achieving desired outcomes – particularly in the western portion of the range (Miller et al. 2011; USFWS 2010; 2013). Management responses to date have not been able to match the scale of this problem. Natural resource managers are seeking coordinated approaches that focus appropriate management actions in the right places to maximize conservation effectiveness (Wisdom and Chambers 2009; Murphy et al. 2013).

Improving our ability to manage for resilience to disturbance and resistance to invasive species is fundamental to achieving long-term sage-grouse conservation objectives. Resilient ecosystems have the capacity to ***regain*** their fundamental structure, processes, and functioning when altered by stressors like drought and disturbances like inappropriate livestock grazing and altered fire regimes (Holling 1973; Allen et al. 2005). Species resilience refers to the ability of a species to recover from stressors and disturbances (USFWS 2013), and is closely linked to ecosystem resilience. Resistant ecosystems have the capacity to ***retain*** their fundamental structure, processes, and functioning when exposed to stresses, disturbances, or invasive species (Folke et al. 2004). Resistance to invasion by nonnative plants is increasingly important in sagebrush ecosystems; it is a function of the abiotic and biotic attributes and ecological processes of an ecosystem that limit the population growth of an invading species (D'Antonio and Thomsen 2004**)**. A detailed explanation of the factors that influence resilience and resistance in sagebrush ecosystems is found in Chambers et al. 2014.

In general, species are likely to be more resilient if large populations exist in large blocks of high quality habitat across the full breadth of environmental variability to which the species is adapted (Redford et al. 2011). Because sage-grouse are a broadly distributed and often wide-ranging species that may move long-distances between seasonal habitats (Connelly et al. 2011a,b), a strategic approach that integrates both landscape prioritization and site-scale decision tools is needed. This document develops such an approach for the conservation of sagebrush habitats across the range of sage-grouse with an emphasis on the western portion of the range. In recent years, information and tools have been developed that significantly increase our understanding of factors that influence the resilience of sagebrush ecosystems and the distribution of sage-grouse populations, and that allow us to strategically prioritize management activities where they are most likely to be effective and to benefit the species. Although the emphasis of this Report is on the western portion of the sage-grouse range, the approach has management applicability to other sagebrush ecosystems.

In this report, we briefly review causes and effects of invasive annual grasses and altered fire regimes, and then discuss factors that determine resilience to disturbances like wildfire and resistance to invasive annual grasses in sagebrush ecosystems. We illustrate how an understanding of resilience and resistance, sagebrush habitat requirements for sage-grouse, and consequences that invasive annual grasses and wildfire have on sage-grouse populations can be used to develop management strategies at both landscape and site scales. A sage-grouse habitat matrix is provided that links relative resilience and resistance with habitat requirements for landscape cover of sagebrush to both identify priority areas for management and determine effective management strategies at landscape scales. An approach for assessing focal areas for sage-grouse habitat management is described that overlays Priority Areas for Conservation (PACs) and breeding bird densities with resilience and resistance and habitat suitability to spatially link sage-grouse populations with habitat conditions and risks. The use of this approach is illustrated for the western portion of the range and for a diverse area in the northeast corner of Nevada. It concludes with a discussion of the tools available for determining the suitability of focal areas for treatment and the most appropriate management treatments. Throughout the document, the emphasis is on using this approach to guide and assist fire operations, fuels management, post-fire rehabilitation, and habitat restoration activities to maintain or enhance sage-grouse habitat.

Threats of Invasive Annual Grasses and Altered Fire Regimes to Sagebrush Ecosystems and Sage-Grouse

Effects on Sagebrush Ecosystems

Sage-grouse habitat loss and fragmentation due to wildfire and invasive plants are widely recognized as two of the most significant challenges to conservation of the species, particularly in the western portion of the range (Miller et al. 2011; USFWS 2010, 2013). During pre-settlement times, sagebrush-dominated ecosystems had highly variable fire return intervals that ranged from decades to centuries (Frost 1998; Brown and Smith 2000; Miller et al. 2011). At coarse regional scales, fire return intervals in sagebrush ecological types were determined largely by climate and its effects on fuel abundance and continuity. Consequently, fire frequency was higher in sagebrush types with greater productivity at higher elevations and following periods of increased precipitation than in lower elevation and less productive ecosystems (West 1983b; Mensing et al. 2006). At local scales within sagebrush types, fire return intervals likely were determined by topographic and soil effects on productivity and fuels and exhibited high spatial and temporal variability (Miller and Heyerdahl 2008).

Euro-American arrival in sagebrush ecosystems began in the mid-1800s and initiated a series of changes in vegetation composition and structure that altered fire regimes and resulted in major changes in sagebrush habitats. The first major change in fire regimes occurred when inappropriate grazing by livestock led to a decrease in native perennial grasses and forbs and effectively reduced the abundance of fine fuels (Knapp 1996; Miller and Eddleman 2001; Miller et al. 2011). Decreased competition from perennial herbaceous species, in combination with ongoing climate change and favorable conditions for woody species establishment at the turn of the twentieth century, resulted in increased abundance of shrubs (primarily *Artemisia* species) and trees, including juniper (*Juniperus occidentalis*, *J. osteosperma*) and piñon pine (*Pinus monophylla*), at mid to high elevations (Miller and Eddleman 2001; Miller et al. 2011). The initial effect of these changes in fuel structure was a reduction in fire frequency and size. The second major change in fire regimes occurred when non-native annual grasses (e.g., *Bromus tectorum, Taeniatherum caput-medusa*) were introduced from Eurasia in the late 1800s and spread rapidly into low to mid-elevation ecosystems with depleted understories (Knapp 1996). The invasive annual grasses increased the amount and continuity of fine fuels in many lower elevation sagebrush habitats and initiated annual grass/fire cycles characterized by shortened fire return intervals and larger, more contiguous fires (fig. 2; D'Antonio and Vitousek 1992; Brooks et al. 2004). Since settlement of the region, cheatgrass came to dominate as much as 4 million hectares (9.9 million acres) in the states of Nevada and Utah alone (fig. 3; Bradley and Mustard 2005). The final change in fire regimes occurred as a result of expansion of juniper and piñon pine trees into sagebrush types at mid to high elevations and a reduction of the grass, forb, and shrub species associated with these types. Ongoing infilling of trees is increasing woody fuels, but reducing fine fuels and resulting in less frequent fires (fig. 4; Miller et al. 2013). Extreme burning conditions (high winds, high temperatures, and low relative humidity) in high density (Phase III) stands are resulting in large and severe fires that result in significant losses of above- and below-ground organic matter (sensu Keeley 2009) and have detrimental ecosystem effects (Miller et al. 2013). Based on tree-ring analyses at several Great Basin sites, it is estimated that the extent of piñon and/or juniper woodland increased two to six fold since settlement, and most of that area will exhibit canopy closure within the next 50 years (Miller et al. 2008).

Figure 2. A wildfire that burned through a Wyoming big sagebrush ecosystem with an invasive annual grass understory in southern Idaho (top) (photo by Douglas J. Shinneman), and a close-up of a fire in a Wyoming big sagebrush ecosystem (bottom) (photo by Scott Schaff).

Figure 3. A wildfire that started in invasive annual grass adjacent to a railroad track and burned upslope into a mountain big sagebrush and Jeffrey pine ecosystem in northeast Nevada (top). A big sagebrush ecosystem that has been converted to invasive annual grass in north central Nevada (bottom) (photos by Nolan E. Preece).

Figure 4. Expansion of Utah juniper trees into a mountain big sagebrush ecosystem in east central Utah (top) that is resulting in progressive infilling of the trees and exclusion of native understory species (bottom) (photos by Bruce A. Roundy).

Effects on Sage-Grouse Habitat Selection and Population Dynamics

Understanding the effects of landscape changes on sage-grouse habitat selection and population dynamics can help managers apply more strategic and targeted conservation actions to reduce risks. Two key land cover shifts resulting from invasive annual grasses and altered fire regimes are affecting the ability to achieve the range-wide goal of stable-to-increasing population trends − large-scale reduction of sagebrush cover and conversion of sagebrush ecosystems to annual grasslands.

Sage-grouse are true sagebrush obligates that require large and intact sagebrush landscapes. Consequently, wildfires occurring at the extremes of the natural range of variability that remove sagebrush, even temporarily, over large areas and over short time periods often have negative consequences for sage-grouse. Several range-wide studies have identified the proportion of sagebrush-dominated land cover as a key indicator of sage-grouse population persistence and, importantly, have revealed critical levels of sagebrush landscape cover required by sage-grouse (see Appendix 2 for a description of landscape cover and how it is derived). Knick et al. (2013) found that 90% of active leks in the western portion of the range had more than 40% landscape cover of sagebrush within a 5-km (3.1-mi) radius of leks. Another range-wide analysis documented a high risk of extirpation with <27% sagebrush landscape cover and high probability of persistence with >50% sagebrush landscape cover within 18-km (11.2-mi) of leks (Wisdom et al. 2011). Similarly, Aldridge et al. (2008) found long-term sage-grouse persistence required a minimum of 25%, and preferably at least 65%, sagebrush landscape cover at the 30-km (18.6-mi) scale. Considered collectively, cumulative disturbances that reduce the cover of sagebrush to less than a quarter of the landscape have a high likelihood of resulting in local population extirpation, while the probability of maintaining persistent populations goes up considerably as the proportion of sagebrush cover exceeds two-thirds or more of the landscape. Reduction of sagebrush cover is most critical in low to mid elevations where natural recovery of sagebrush can be very limited within timeframes important to sage-grouse population dynamics (Davies et al. 2011).

Nonnative annual grasses and forbs have invaded vast portions of the sage-grouse range, reducing both habitat quantity and quality (Beck and Mitchell 2000; Rowland et al. 2006; Miller et al. 2011; Balch et al. 2013). Due to repeated fires, some low- to mid-elevation native sagebrush communities are shifting to novel annual grassland states resulting in habitat loss that may be irreversible with current technologies (Davies et al. 2011; Miller et al. 2011; Chambers et al. 2014). At the broadest scales, the presence of non-native annual grasslands on the landscape may be influencing both sage-grouse distribution and abundance. In their analysis of active leks, Knick et al. (2013) found that most leks had very little annual grassland cover (2.2%) within a 5-km (3.1-mi) radius of the leks; leks that were no longer used had almost five times as much annual grassland cover as active leks. Johnson et al. (2011) found that lek use became progressively less as the cover of invasive annual species increased at both the 5-km (3.1-mi) and 18-km (11.2-mi) scales. Also, few leks had >8% invasive annual vegetation cover within both buffer distances.

Patterns of nest site selection also suggest local impacts of invasive annual grasses on birds. In western Nevada, Lockyer (2012) found that sage-grouse selected large expanses of sagebrush-dominated areas and, within those areas, sage-grouse selected microsites with higher shrub canopy cover and lower cheatgrass cover. Average cheatgrass cover at selected locations was 7.1% compared to 13.3% at available locations. Sage-grouse hens essentially avoided nesting in areas with higher cheatgrass cover. Kirol et al. (2012) also found nest-site selection was negatively correlated with the presence of cheatgrass in south-central Wyoming.

Sage-grouse population demographic studies in northern Nevada show that recruitment and annual survival also are affected by presence of annual grasslands at larger scales. Blomberg et al. (2012) analyzed land cover within a 5-km (3.1-mi) radius of leks and found that leks impacted by annual grasslands experienced lower recruitment than non-impacted leks, even following years of high precipitation. Leks that were not affected by invasive annual grasslands exhibited recruitment rates nearly twice as high as the population average and nearly six times greater than affected leks during years of high precipitation.

Piñon and juniper expansion at mid to upper elevations into sagebrush ecosystems also has altered fire regimes and reduced sage-grouse habitat availability and suitability over large areas with population-level consequences (Miller et al. 2011; Baruch-Mordo et al. 2013; Knick et al. 2013). Conifer expansion results in non-linear declines in sagebrush cover and reductions in perennial native grasses and forbs as conifer canopy cover increases (Miller et al. 2000) and this has direct effects on the amount of available habitat for sagebrush-obligate species. Sites in the late stage of piñon and juniper expansion and infilling (Phase III from Miller et al. 2005) have reduced fire frequency (due to decreased fine fuels), but are prone to higher severity fires (due to increased woody fuels) which significantly reduces the likelihood of sagebrush habitat recovery (fig. 5) (Bates et al. 2013). Even before direct habitat loss occurs, sage-grouse avoid or are negatively associated with conifer cover during all life stages (i.e., nesting, brood-rearing, and wintering; Doherty et al. 2008, 2010a; Atamian et al. 2010; Casazza et al. 2011). Also, sage-grouse incur population-level impacts at a very low level of conifer encroachment. The ability to maintain active leks is severely compromised when conifer canopy exceeds 4% in the immediate vicinity of the lek (Baruch-Mordo et al. 2013), and most active leks average less than 1% conifer cover at landscape scales (Knick et al. 2013).

Figure 5. A post-burn, Phase III, singleleaf piñon and Utah juniper dominated sagebrush ecosystem in which soils are highly erosive and few understory plants remain (photo by Jeanne C. Chambers).

Resilience to Disturbance and Resistance to Invasive Annual Grasses in Sagebrush Ecosystems

Our ability to address the changes occurring in sagebrush habitats can be greatly enhanced by understanding the effects of environmental conditions on resilience to stress and disturbance, and resistance to invasion (Wisdom and Chambers 2009; Brooks and Chambers 2011; Chambers et al. 2014). In cold desert ecosystems, resilience of native ecosystems to stress and disturbance changes along climatic and topographic gradients. In these ecosystems, Wyoming big sagebrush (*Artemisia tridentata* spp. *wyomingensis*), mountain big sagebrush (*A. t.* spp. *vaseyana*), and mountain brush types (e.g., mountain big sagebrush, snowberry [*Symphorocarpus* spp.], bitterbrush [*Purshia tridentata*]) occur at progressively higher elevations and are associated with decreasing temperatures and increasing amounts of precipitation, productivity, and fuels (fig. 6; West and Young 2000). Piñon pine and juniper woodlands are typically associated with mountain big sagebrush types, but can occur with relatively cool and moist Wyoming big sagebrush types and warm and moist mountain brush types (Miller et al. 2013). Resilience to disturbance, including wildfire, has been shown to increase along these elevation gradients (fig. 7A) (Condon et al. 2011; Davies et al. 2012; Chambers et al. 2014; Chambers et al. *in press*). Higher precipitation and cooler temperatures, coupled with greater soil development and plant productivity at mid to high elevations, can result in greater resources and more favorable environmental conditions for plant growth and reproduction (Alexander et al. 1993; Dahlgren et al. 1997). In contrast, minimal precipitation and high temperatures at low elevations result in lower resource availability for plant growth (West 1983a,b;

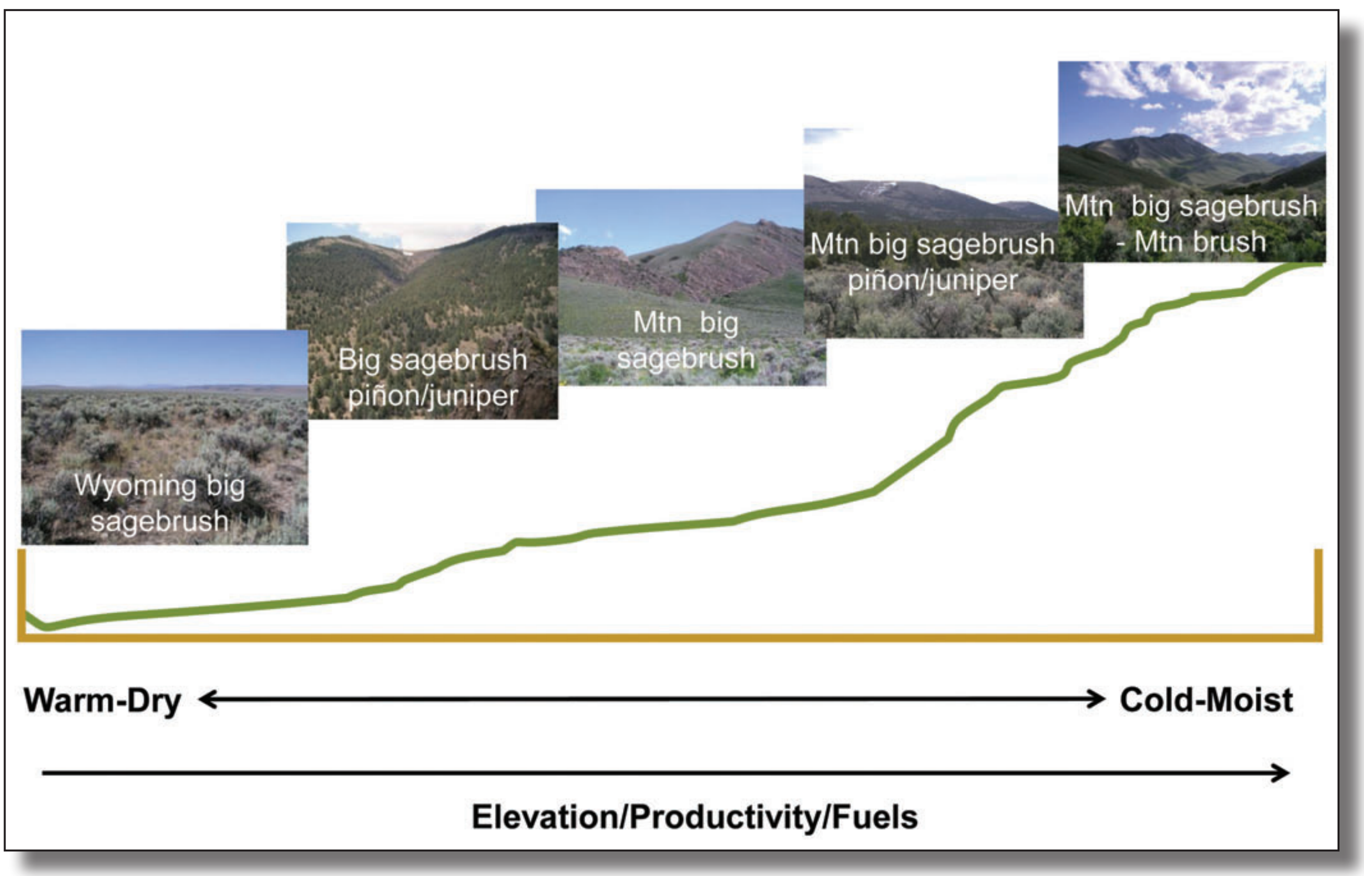

Figure 6. The dominant sagebrush ecological types that occur along environmental gradients in the western United States. As elevation increases, soil temperature and moisture regimes transition from warm and dry to cold and moist and vegetation productivity and fuels become higher.

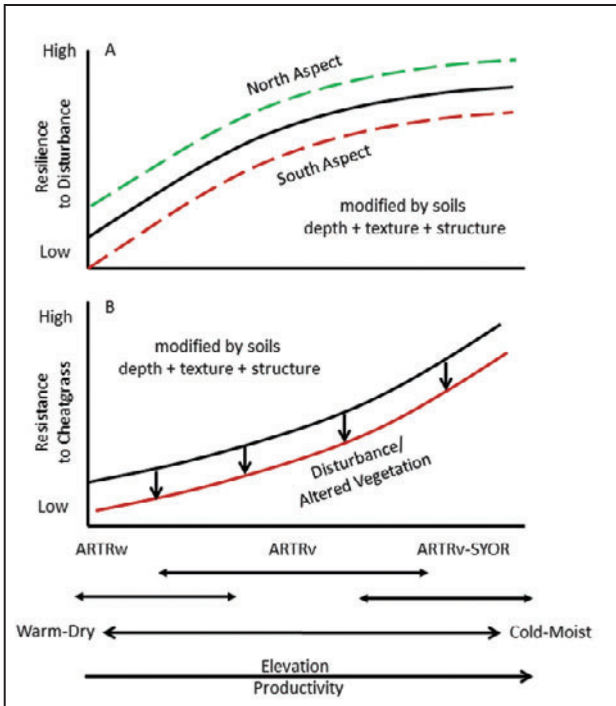

Figure 7. (**A)** Resilience to disturbance and (**B)** resistance to cheatgrass over a typical temperature/precipitation gradient in the cold desert. Dominant ecological sites occur along a continuum that includes Wyoming big sagebrush on warm and dry sites, to mountain big sagebrush on cool and moist sites, to mountain big sagebrush and root-sprouting shrubs on cold and moist sites. Resilience increases along the temperature/precipitation gradient and is influenced by site characteristics like aspect. Resistance also increases along the temperature/precipitation gradient and is affected by disturbances and management treatments that alter vegetation structure and composition and increase resource availability (modified from Chambers et al. 2014; Chambers et al. *in press*).

Smith and Nowak 1990). These relationships also are observed at local plant community scales where aspect, slope, and topographic position affect solar radiation, erosion processes, effective precipitation, soil development and vegetation composition and structure (Condon et al. 2011; Johnson and Miller 2006).

Resistance to invasive annual grasses depends on environmental factors and ecosystem attributes and is a function of (1) the invasive species' physiological and life history requirements for establishment, growth, and reproduction, and (2) interactions with the native perennial plant community including interspecific competition and response to herbivory and pathogens. In cold desert ecosystems, resistance is strongly influenced by soil temperature and moisture regimes (Chambers et al. 2007; Meyer et al. 2001). Germination, growth, and/or reproduction of cheatgrass is physiologically limited at low elevations by frequent, low precipitation years, constrained at high elevations by low soil temperatures, and optimal at mid elevations under relatively moderate temperature and water availability (fig. 7B; Meyer et al. 2001; Chambers et al. 2007). Slope, aspect, and soil characteristics modify soil temperature and moisture and influence resistance to cheatgrass at landscape to plant community scales (Chambers et al. 2007; Condon et al. 2011; Reisner et al. 2013). Genetic variation in cheatgrass results in phenotypic traits that increase survival and persistence in populations from a range of environments, and is likely contributing to the recent range expansion of this highly inbreeding species into marginal habitats (Ramakrishnan et al. 2006; Merrill et al. 2012).

The occurrence and persistence of invasive annual grasses in sagebrush habitats is strongly influenced by interactions with the native perennial plant community (fig. 7B). Cheatgrass, a facultative winter annual that can germinate from early fall through early spring, exhibits root elongation at low soil temperatures, and has higher nutrient uptake and growth rates than most native species (Mack and Pyke 1983; Arredondo et al. 1998; James et al. 2011). Seedlings of native, perennial plant species are generally poor competitors with cheatgrass, but adults of native, perennial grasses and forbs, especially those with similar growth forms and phenology, can be highly effective competitors with the invasive annual (Booth et al. 2003; Chambers et al. 2007; Blank and Morgan 2012).

Also, biological soil crusts, which are an important component of plant communities in warmer and drier sagebrush ecosystems, can reduce germination or establishment of cheatgrass (Eckert et al. 1986; Kaltenecker et al. 1999). Disturbances or management treatments that reduce abundance of native perennial plants and biological soil crusts and increase the distances between perennial plants often are associated with higher resource availability and increased competitive ability of cheatgrass (Chambers et al. 2007; Reisner et al. 2013; Roundy et al. *in press*).

The type, characteristics, and natural range of variability of stress and disturbance strongly influence both resilience and resistance (Jackson 2006). Disturbances like overgrazing of perennial plants by livestock, wild horses, and burros and more frequent or more severe fires are typically outside of the natural range of conditions and can reduce the resilience of sagebrush ecosystems. Reduced resilience is triggered by changes in environmental factors like temperature regimes, abiotic attributes like water and nutrient availability, and biotic attributes such as vegetation structure, composition, and productivity (Chambers et al. 2014) and cover of biological soil crusts (Reisner et al. 2013). Resistance to an invasive species can change when changes in abiotic and biotic attributes result in increased resource availability or altered habitat suitability that influences an invasive species' ability to establish and persist and/or compete with native species. Progressive losses of resilience and resistance can result in the crossing of abiotic and/or biotic thresholds and an inability of the system to recover to the reference state (Beisner et al. 2003; Seastedt et al. 2008).

Interactions among disturbances and stressors may have cumulative effects (Chambers et al. 2014). Climate change already may be shifting fire regimes outside of the natural range of occurrence (i.e., longer wildfire seasons with more frequent and longer duration wildfires) (Westerling et al. 2006). Sagebrush ecosystems generally have low productivity, and the largest number of acres burned often occurs a year or two after warm, wet conditions in winter and spring that result in higher fine fuel loads (Littell et al. 2009). Thus, annual grass fire cycles may be promoted by warm, wet winters and a subsequent increase in establishment and growth of invasive winter annuals. These cycles may be exacerbated by rising atmospheric CO_2 concentrations, N deposition, and increases in human activities that result in soil surface disturbance and invasion corridors (Chambers et al. 2014). Modern deviations from historic conditions will likely continue to alter disturbance regimes and sagebrush ecosystem response to disturbances; thus, management strategies that rely on returning to historical or "pre-settlement" conditions may be insufficient, or even misguided, given novel ecosystem dynamics (Davies et al. 2009).

Integrating Resilience and Resistance Concepts With Sage-Grouse Habitat Requirements to Manage Wildfire and Invasive Annual Grass Threats at Landscape Scales

The changes in sagebrush ecosystem dynamics due to invasive annual species and longer, hotter, and drier fire seasons due to a warming climate make it unlikely that these threats can be ameliorated completely (Abatzoglou and Kolden 2011; USFWS 2013). Consequently, a strategic approach is necessary to conserve sagebrush habitat and sage-grouse (Wisdom et al. 2005; Meinke et al. 2009; Wisdom and Chambers 2009; Pyke 2011). This strategic approach requires the ability to (1) identify those locations that provide current or potential habitat for sage-grouse and (2) prioritize management actions based on the capacity of the ecosystem to respond in the desired manner and to effectively allocate resources to achieve desired objectives. Current understanding of the relationship of landscape cover of sagebrush to sage-grouse habitat provides the capacity to identify those locations on the landscape that have a high probability of sage-grouse persistence (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Similarly, knowledge of the relationships of environmental characteristics, specifically soil temperature and moisture regimes, to ecological types and their inherent resilience and resistance gives us the capacity to prioritize management actions based on probable effectiveness of those actions (Wisdom and Chambers 2009; Brooks and Chambers 2011; Miller et al. 2013; Chambers et al. 2014; Chambers et al. *in press,*).

In this section, we discuss the use of landscape cover of sagebrush as an indicator of sage-grouse habitat, and the use of soil temperature and moisture regimes as an indicator of resilience to disturbance, resistance to invasive annual grasses and, ultimately, the capacity to achieve desired objectives. We then show how these two concepts can be coupled in a sage-grouse habitat matrix and used to determine potential management strategies at the landscape scales on which sage-grouse depends.

Landscape Cover of Sagebrush as an Indicator of Sage-Grouse Habitat

Landscape cover of sagebrush is closely related to the probability of maintaining active sage-grouse leks, and is used as one of the primary indicators of sage-grouse habitat potential at landscape scales (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Landscape cover of sagebrush less than about 25% has a low probability of sustaining active sage-grouse leks (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Above 25% landscape cover of sagebrush, the probability of maintaining active sage-grouse leks increases with increasing sagebrush landscape cover. At landscape cover of sagebrush ranging from 50 to 85%, the probability of sustaining sage-grouse leks becomes relatively constant (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). For purposes of prioritizing landscapes for sage-grouse habitat management, we use 25% as the level below which there is a low probability of maintaining sage-grouse leks and 65% as the level above which there is little additional increase in the probability of sustaining active leks with further increases of landscape cover of sagebrush (fig. 8; Knick et al. 2013). Between about 25% and 65% landscape sagebrush cover, increases in landscape cover of sagebrush have a constant positive relationship with sage-grouse lek probability (fig. 8; Knick et al. 2013). Restoration and management activities that result in an increase in the amount of sagebrush dominated landscape within areas of pre-existing landscape cover between 25% and 65% likely will result in a higher probability of sage-grouse persistence, while declines in landscape cover of sagebrush likely will result in reductions in sage-grouse (Knick et al. 2013). It is important to note that

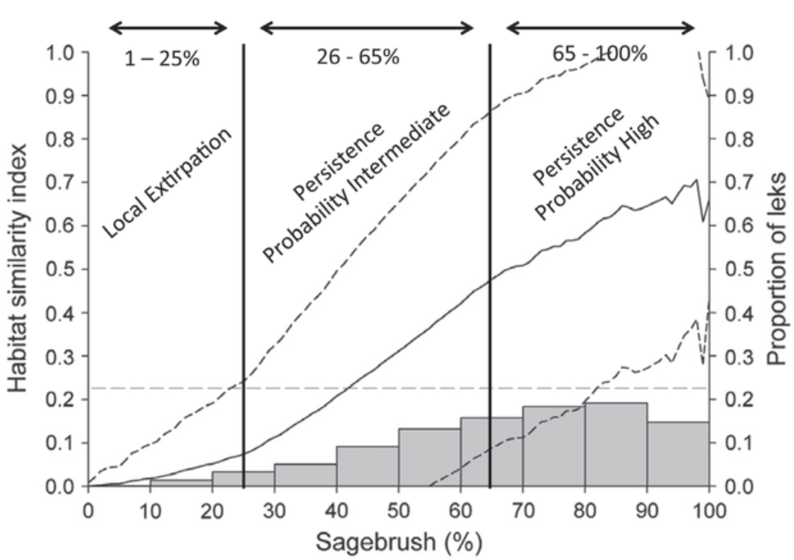

Figure 8. The proportion of sage-grouse leks and habitat similarity index (HSI) as related to the percent landscape cover of sagebrush. The HSI indicates the relationship of environmental variables at map locations across the western portion of the range to minimum requirements for sage-grouse defined by land cover, anthropogenic variables, soil, topography, and climate. HSI is the solid black line ± 1 SD (stippled lines). Proportion of leks are the grey bars. Dashed line indicates HSI values above which characterizes 90% of active leks (0.22). The categories at the top of the figure and the interpretation of lek persistence were added based on Aldridge et al. 2008; Wisdom et al. 2011; and Knick et al. 2013 (figure modified from Knick et al. 2013).

these data and interpretations relate only to persistence (i.e., whether or not a lek remains active) and it is likely that higher proportions of sagebrush cover or improved condition of sagebrush ecosystems may be required for population growth.

For the purposes of delineating sagebrush habitat relative to sage-grouse requirements for landscape cover of sagebrush, we calculated the percentage landscape sagebrush cover within each of the selected categories (1-25%, 26-65%, >65%) for the range of sage-grouse (fig. 9, 10). An explanation of how landscape cover of sagebrush is derived is in Appendix 2. Large areas of landscape sagebrush cover >65% are found primarily in Management Zones (MZ) II (Wyoming Basin), IV (Snake River Plains), and V (Northern Great Basin). In contrast, relatively small areas of landscape sagebrush cover >65% are located in MZ I (Great Plains), III (Southern Great Basin), VI (Columbia Basin), and VII (Colorado Plateau). Sagebrush is naturally less common in the Great Plains region compared to other parts of the range and previous work suggested that sage-grouse populations in MZ I may be more vulnerable to extirpation with further reductions in sagebrush cover (Wisdom et al. 2011). In the western portion of the range, where the threat of invasive annual grasses and wildfire is greatest, the area of sagebrush cover >65% differs among MZs. MZ III is a relatively arid and topographically diverse area in which the greatest extent of sagebrush cover >65% is in higher elevation, mountainous areas. MZs IV and V have relatively large extents of sagebrush cover >65% in relatively cooler and wetter areas, and MZs IV and VI have lower extents of sagebrush cover >65% in warmer and dryer areas and in areas with significant agricultural development. These differences in landscape cover of sagebrush indicate that different sets of management strategies may apply to the various MZs.

Soil Temperature and Moisture Regimes as Indicators of Ecosystem Resilience and Resistance

Potential resilience and resistance to invasive annual grasses reflect the biophysical conditions that an area is capable of supporting. In general, the highest potential resilience and resistance occur with ***cool*** to ***cold*** (frigid to cryic) soil temperature regimes and relatively ***moist*** (xeric to ustic) soil moisture regimes, while the lowest potential resilience and resistance occur with ***warm*** (mesic) soil temperatures and relatively ***dry*** (aridic) soil moisture regimes (Chambers et al. 2014, Chambers et al. *in press*). Definitions of soil temperature and moisture regimes are in Appendix 3. Productivity is elevated by high soil moisture and thus resilience is increased (Chambers et al. 2014); annual grass growth and reproduction is limited by cold soil temperatures and thus resistance is increased (Chambers et al. 2007). The timing of precipitation also is important because cheatgrass and many other invasive annual grasses are particularly well-adapted to Mediterranean type climates with cool and wet winters and warm and dry summers (Bradford and Lauenroth 2006; Bradley 2009). In contrast, areas that receive regular summer precipitation (ustic soil moisture regimes) often are dominated by warm and/or cool season grasses (Sala et al. 1997) that likely create a more competitive environment and result in greater resistance to annual grass invasion and spread (Bradford and Lauenroth 2006; Bradley 2009).

Much of the remaining sage-grouse habitat in MZs I (Great Plains), II (Wyoming Basin), VII (Colorado Plateau), and cool-to-cold or moist sites scattered across the range, are characterized by moderate to high resilience and resistance as indicated by soil temperature and moisture regimes (fig. 11). Sagebrush habitats across MZ I are unique from a range-wide perspective because soils are predominantly cool and ustic, or bordering on ustic as a result of summer precipitation; this soil moisture regime appears to result in higher resilience and resistance (Bradford and Lauenroth 2006).

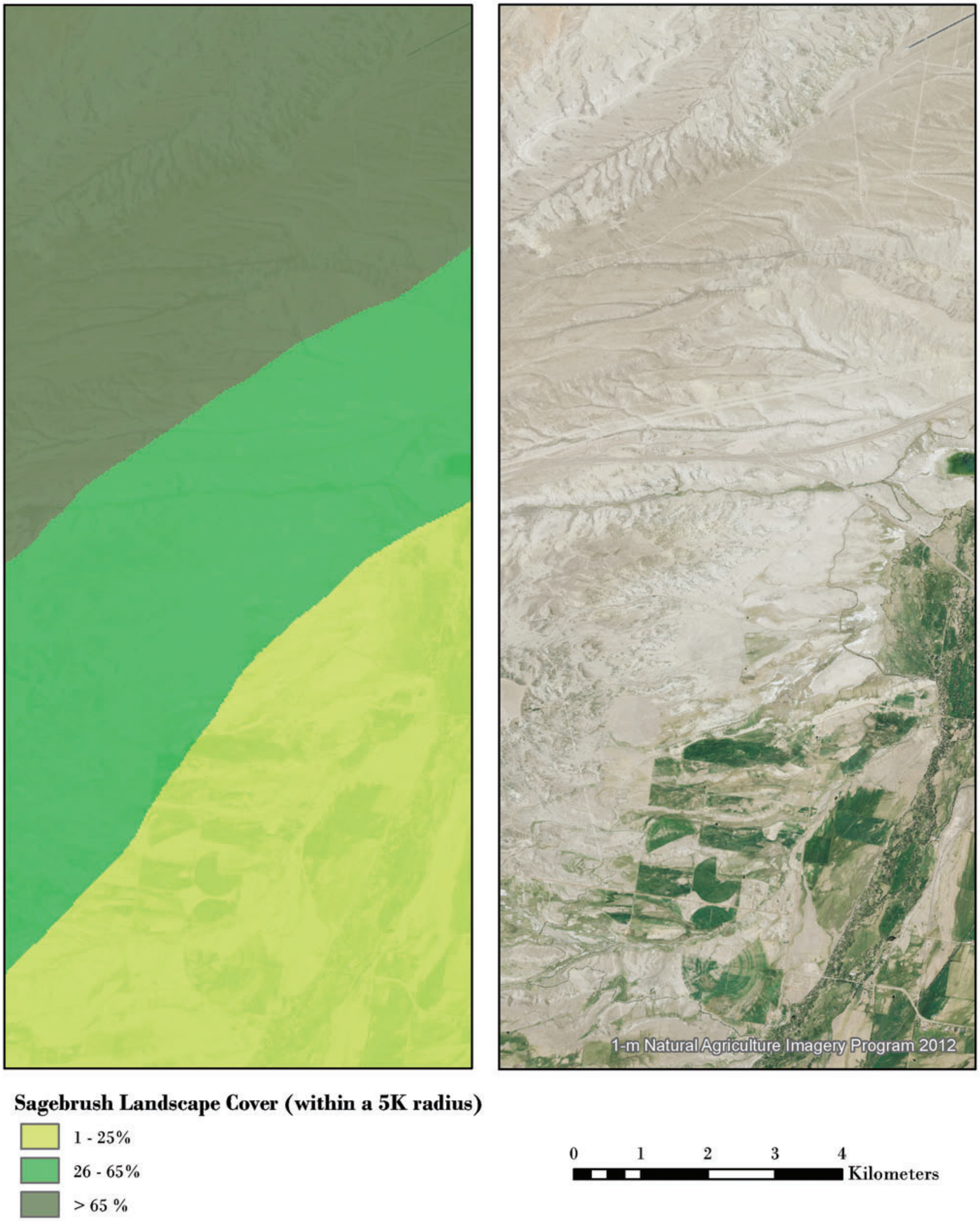

Figure 9. Landscape cover of sagebrush from 1-m National Agricultural Imagery (right) and the corresponding sagebrush landscape cover for the 1-25%, 26-65%, and >65% categories (left). See Appendix 2 for an explanation of how the categories are determined.

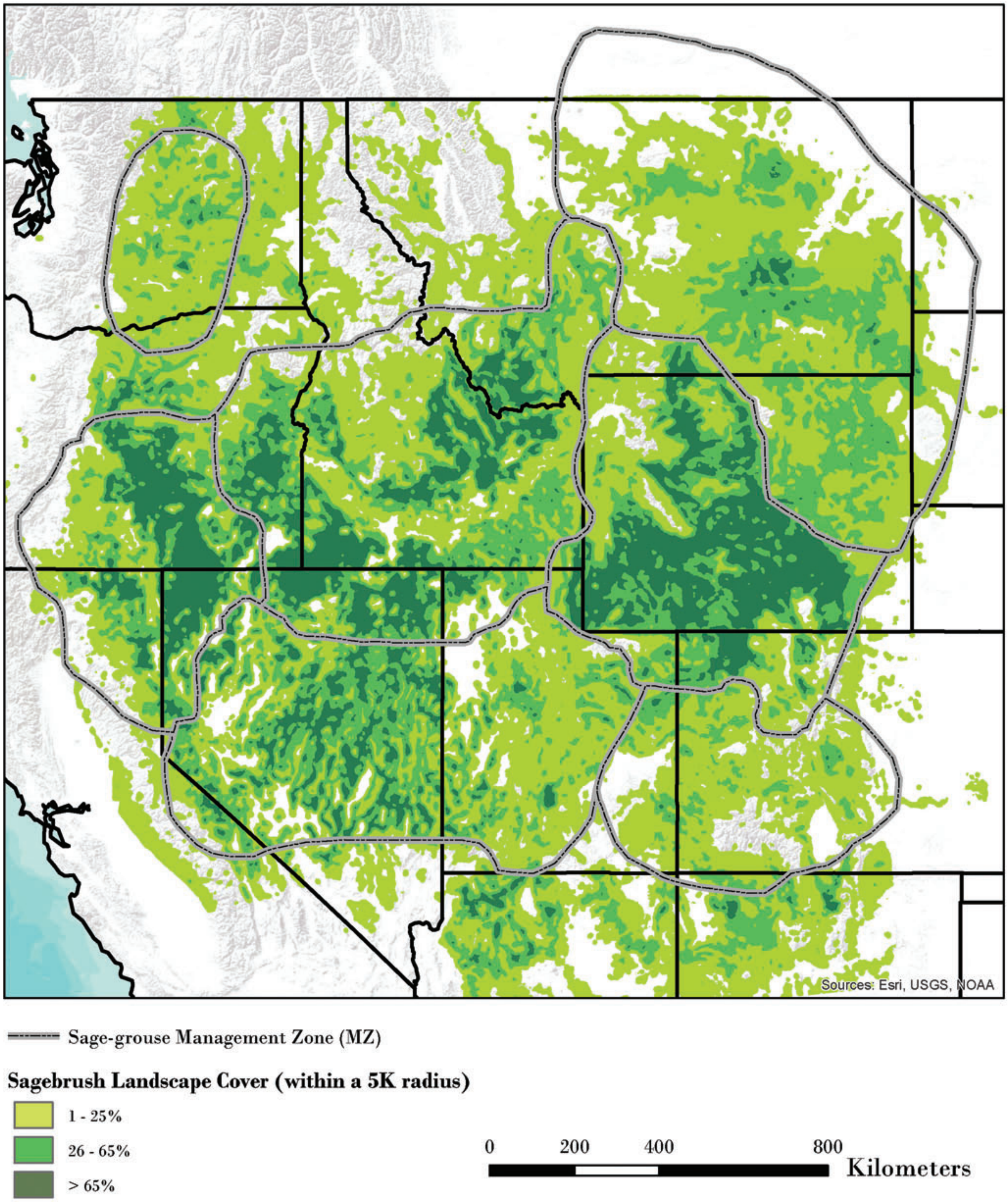

Figure 10. The landscape cover of sagebrush within each of three selected categories (1-25%, 26-65%, >65%) for the range of sage-grouse (Management Zones I – VII; Stiver et al. 2006). The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover.

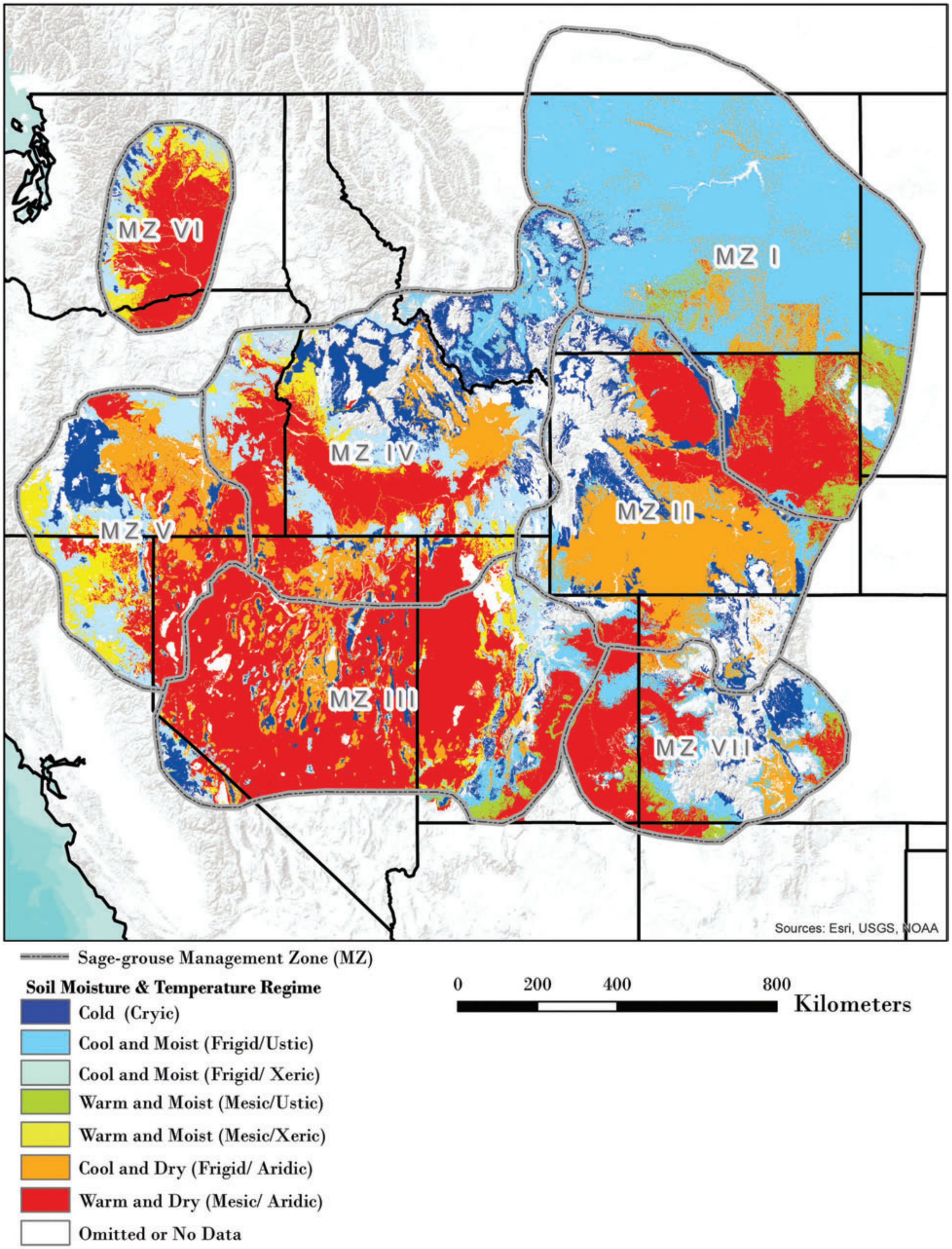

Figure 11. The soil temperature and moisture regimes for the range of sage-grouse (Management Zones I – VII; Stiver et al. 2006). Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b).

However, significant portions of MZs III (Southern Great Basin), much of IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin) are characterized largely by either warm and dry, or warm to cool and moist ecological types with moderate to low resilience and resistance (fig. 11; table 1). Areas within these MZs that have warm and dry soils are typically characterized by Wyoming big sagebrush ecosystems with low to moderately low resilience and resistance and are currently of greatest concern for sage-grouse conservation (fig. 12A). Areas with warm to cool soil temperature regimes and moist precipitation regimes are typically characterized by either Wyoming or mountain big sagebrush, have moderate to moderately low resilience and resistance,

Table 1. Predominant sagebrush ecological types in Sage-Grouse Management Zones III, IV, V, and VI based on soil temperature and soil moisture regimes, typical characteristics, and resilience to disturbance and resistance to invasive annual grasses (modified from Miller et al. 2014 a,b). Relative abundance of sagebrush species and composition of understory vegetation vary depending on Major Land Resource Area and ecological site type.

Ecological type	Characteristics	Resilience and resistance
Cold and Moist (Cryic/Xeric)	Ppt: 14 inches + Typical shrubs: *Mountain big sagebrush, snowfield sagebrush, snowberry, serviceberry, silver sagebrush, and/or low sagebrushes*	*Resilience* – **Moderately high**. Precipitation and productivity are generally high. Short growing seasons can decrease resilience on coldest sites. *Resistance*– **High**. Low climate suitability to invasive annual grasses
Cool and Moist (Frigid/Xeric)	Ppt: 12-22 inches Typical shrubs: *Mountain big sagebrush, antelope bitterbrush, snowberry, and/or low sagebrushes* Piñon pine and juniper potential in some areas	*Resilience* – **Moderately high**. Precipitation and productivity are generally high. Decreases in site productivity, herbaceous perennial species, and ecological conditions can decrease resilience. *Resistance* – **Moderate**. Climate suitability to invasive annual grasses is moderate, but increases as soil temperatures increase.
Warm and Moist (Mesic/Xeric)	Ppt: 12-16 inches Typical shrubs: *Wyoming big sagebrush, mountain big sagebrush, Bonneville big sagebrush, and/or low sagebrushes* Piñon pine and juniper potential in some areas	*Resilience* – **Moderate**. Precipitation and productivity are moderately high. Decreases in site productivity, herbaceous perennial species, and ecological conditions can decrease resilience. *Resistance* – **Moderately low**. Climate suitability to invasive annual grasses is moderately low, but increases as soil temperatures increase.
Cool and Dry (Frigid/Aridic)	Ppt: 6-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush, and/or low sagebrushes*	*Resilience* – **Low**. Effective precipitation limits site productivity. Decreases in site productivity, herbaceous perennial species, and ecological conditions further decrease resilience. *Resistance* – **Moderate**. Climate suitability to invasive annual grasses is moderate, but increases as soil temperatures increase.
Warm and Dry (Mesic/Aridic, bordering on Xeric)	Ppt: 8-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush and/or low sagebrushes*	*Resilience* – **Low.** Effective precipitation limits site productivity. Decreases in site productivity, herbaceous perennial species, and ecological conditions further decrease resilience. Cool season grasses susceptibility to grazing and fire, along with hot dry summer fire conditions, promote cheatgrass establishment and persistence. *Resistance* – **Low.** High climate suitability to cheatgrass and other invasive annual grasses. Resistance generally decreases as soil temperature increases, but establishment and growth are highly dependent on precipitation.

and have the potential for piñon and juniper expansion (Miller et al. 2014a; Chambers et al. *in press*). Many of these areas also are of conservation concern because piñon and juniper expansion and tree infilling can result in progressive loss of understory species and altered fire regimes (Miller et al. 2013). In contrast, areas with cool to cold soil temperature regimes and moist precipitation regimes have moderately high resilience and high resistance and are likely to recover in a reasonable amount of time following wildfires and other disturbances (Miller et al. 2013) (fig. 12B)

Figure 12. A Wyoming big sagebrush ecosystem with warm and dry soils in southeast Oregon (top) (photo by Richard F. Miller), compared to a mountain big sagebrush ecosystem with cool and moist soils in central Nevada (bottom) (photo by Jeanne C. Chambers).

Management Strategies Based on Landscape Cover of Sagebrush and Ecosystem Resilience and Resistance: The Sage-Grouse Habitat Matrix

Knowledge of the potential resilience and resistance of sagebrush ecosystems can be used in conjunction with sage-grouse habitat requirements to determine priority areas for management and identify effective management strategies at landscape scales (Wisdom and Chambers 2009). The sage-grouse habitat matrix (table 2) illustrates the relative resilience to disturbance and resistance to invasive annual grasses of sagebrush ecosystems in relation to the proportion of sagebrush cover on the landscape. As resilience and resistance go from high to low, as indicated by the rows in the matrix, decreases in sagebrush regeneration and abundance of perennial grasses and forbs progressively limit the capacity of a sagebrush ecosystem to recover after fire or other disturbances. The risk of annual invasives increases and the ability to successfully restore burned or otherwise disturbed areas decreases. As sagebrush cover goes from low to high within these same ecosystems, as indicated by the columns in the matrix, the capacity to provide adequate habitat cover for sage-grouse increases. Areas with less than 25% landscape cover of sagebrush are unlikely to provide adequate habitat for sage-grouse; areas with 26-65% landscape cover of sagebrush can provide habitat for sage-grouse but are at risk if sagebrush loss occurs without recovery; and areas with >65% landscape cover of sagebrush provide the necessary habitat conditions for sage-grouse to persist. Potential landscape scale management strategies can be determined by considering (1) resilience to disturbance, (2) resistance to invasive annuals, and (3) sage-grouse land cover requirements. Overarching management strategies to maintain or increase sage-grouse habitat at landscape scales based on these considerations are conservation, prevention, restoration, and monitoring and adaptive management (table 3; see Chambers et al. 2014). These strategies have been adapted for each of the primary agency programs including fire operations, fuels management, post-fire rehabilitation, and habitat restoration (table 4). Because sagebrush ecosystems occur over continuums of environmental conditions, such as soil temperature and moisture, and have differing land use histories and species composition, careful assessment of the area of concern always will be necessary to determine the relevance of a particular strategy (Pyke 2011; Chambers et al. 2014; Miller et al. 2014 a, b). The necessary information for conducting this type of assessment is found in the "Putting It All Together" section of this report.

Although the sage-grouse habitat matrix (table 2) can be viewed as partitioning land units into spatially discrete categories (i.e., landscapes or portions thereof can be categorized as belonging to one of nine categories), it is not meant to serve as a strict guide to spatial allocation of resources or to prescribe specific management strategies. Instead, the matrix should serve as a decision support tool for helping managers implement strategies that consider both the resilience and resistance of the landscape and landscape sagebrush cover requirements of sage-grouse. For example, low elevation Wyoming big sagebrush plant communities with relatively low resilience and resistance may provide important winter habitat resources for a given sage-grouse population. In a predominantly Wyoming big sagebrush area comprised of relatively low sagebrush landscape cover, a high level of management input may be needed to realize conservation benefits for sage-grouse. This doesn't mean that management activities should not be undertaken if critical or limiting sage-grouse habitat resources are present, but indicates that inputs will be intensive, potentially more expensive, and less likely to succeed relative to more resilient landscapes. It is up to the user of the matrix to determine how such tradeoffs influence management actions.

Table 2. Sage-grouse habitat matrix based on resilience and resistance concepts from Chambers et al. 2014, and sage-grouse habitat requirements from Aldridge et al. 2008, Wisdom et al. 2011, and Knick et al. 2013. Rows show the ecosystems relative resilience to disturbance and resistance to invasive annual grasses derived from the sagebrush ecological types in table 1 (1 = high resilience and resistance; 2 = moderate resilience and resistance; 3 = low resilience and resistance). Columns show the current proportion of the landscape (5-km rolling window) dominated by sagebrush (A = 1-25% land cover; B = 26-65% land cover; 3 = >65% land cover). Use of the matrix is explained in text. Overarching management strategies that consider resilience and resistance and landscape cover of sagebrush are in table 3. Potential management strategies specific to agency program areas, including fire operations, fuels management, post-fire rehabilitation, and habitat restoration are in table 4.

Proportion of Landscape Dominated by Sagebrush

Ecosystem Resilience to Disturbance and Resistance to Invasive Annual Grasses	**Low 1-25%** Too little sagebrush on the landscape significantly threatens likelihood of sage-grouse persistence.	**Moderate 26-65%** Sage-grouse are sensitive to the amount of sagebrush remaining on the landscape and populations could be at-risk with additional disturbances that remove sagebrush.	**High >65%** Sufficient sagebrush exists on the landscape and sage-grouse are highly likely to persist.
High	**1A** Natural sagebrush recovery is likely to occur, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**1B** Natural sagebrush recovery is likely to occur, but certain areas may lack connectivity.	**1C** Natural sagebrush recovery is likely to occur.
High (all columns)	Perennial herbaceous species are typically sufficient for recovery. Risk of annual invasives is low. Seeding/transplanting success is high. Recovery following inappropriate livestock use is often possible given changes in management.		
Moderate	**2A** Natural sagebrush recovery is likely on cooler and moister sites, but if large, contiguous areas lack sagebrush, the time required for recovery may be too great.	**2B** Natural sagebrush recovery is likely on cooler and moister sites, but certain areas may lack connectivity.	**2C** Natural sagebrush recovery is likely on cooler and moister sites.
Moderate (all columns)	Perennial herbaceous species are usually adequate for recovery on cooler and moister sites. Risk of annual invasives is moderately high on warmer and drier sites. Seeding-transplanting success depends on site characteristics, and more than one intervention may be required especially on warmer and drier sites. Recovery following inappropriate livestock use depends on site characteristics and management.		
Low	**3A** Natural sagebrush recovery is not likely.	**3B** Natural sagebrush recovery may occur, but the time required will likely be too great and certain areas may lack connectivity.	**3C** Natural sagebrush recovery may occur, but the time required will likely be too great.
Low (all columns)	Perennial herbaceous species are typically inadequate for recovery. Risk of annual invasives is high. Seeding/transplanting success depends on site characteristics, annual invasives, and post-treatment precipitation but is often low. More than one intervention likely will be required. Recovery following inappropriate livestock use is unlikely.		

Table 3. Potential management strategies based on resilience to disturbance, resistance to annual grass invasion, and sage-grouse habitat requirements based on Aldridge et al. 2008; Wisdom et al. 2011; and Knick et al. 2013 (adapted from Chambers et al. 2014).

Conserve – maintain or increase resilience to disturbance and resistance to invasive annuals in areas with high conservation value	
Priorities	• Ecosystems with low to moderate resilience to fire and resistance to invasive species that still have large patches of landscape sagebrush cover and adequate perennial grasses and forbs – *ecological types with warm and dry and cool and dry soil temperature/moisture regimes.* • Ecosystems with a high probability of providing habitat for sage-grouse, especially those with >65% landscape cover of sagebrush and adequate perennial herbaceous species – *all ecological types.*
Objective	• Minimize impacts of current and future human-caused disturbances and stressors.
Activities	• Immediately suppress fire in moderate to low resilience and resistance sagebrush and wooded shrublands to prevent an invasive annual grass-fire cycle. Large sagebrush patches are high priority for protection from wildfires. • Implement strategic fuel break networks to provide anchor points for suppression and reduce losses when wildfires escape initial attack. • Manage livestock grazing to prevent loss of perennial native grasses and forbs and biological soil crusts and allow natural regeneration. • Limit anthropogenic activities that cause surface disturbance, invasion, and fragmentation. (e.g., road and utility corridors, urban expansion, OHV use, and mineral/energy projects). • Detect and control new weed infestations.
Prevent – maintain or increase resilience and resistance of areas with declining ecological conditions that are at risk of conversion to a degraded, disturbed, or invaded state	
Priorities	• Ecosystems with moderate to high resilience and resistance – *ecological types with relatively cool and moist soil temperature and moisture regimes*. ○ Prioritize landscape patches that exhibit declining conditions due to annual grass invasion and/or tree expansion (e.g., at risk phase in State and Transition Models). • Ecosystems with a moderate to high probability of providing sage-grouse habitat, especially those with 26-65% landscape cover of sagebrush and adequate perennial native grasses and forbs – *all ecological types*.
Objectives	• Reduce fuel loads and decrease the risk of high intensity and high severity fire. • Increase abundance of perennial native grasses and forbs and of biological soil crusts where they naturally occur. • Decrease the longer-term risk of annual invasive grass dominance.
Activities	• Use mechanical treatments like cut and leave or mastication to remove trees, decrease woody fuels, and release native grasses and forbs in warm and moist big sagebrush ecosystems with relatively low resistance to annual invasive grasses that are in the early to mid-phase of piñon and/or juniper expansion. • Use prescribed fire or mechanical treatments to remove trees, decrease woody fuels, and release native grasses and forbs in cool and moist big sagebrush ecosystems with relatively high resistance to annual invasive grass that are in early to mid-phase of piñon and/or juniper expansion. • Actively manage post-treatment areas to increase perennial herbaceous species and minimize secondary weed invasion. • Consider the need for strategic fuel breaks to help constrain fire spread or otherwise augment suppression efforts.
Restore – increase resilience and resistance of disturbed, degraded, or invaded areas	
Priorities	• Areas burned by wildfire – *all ecological types* ○ Prioritize areas with low to moderate resilience and resistance, and that have a reasonable expectation of recovery. ○ Prioritize areas where perennial grasses and forbs have been depleted. ○ Prioritize areas that experienced high severity fire.

(continued)

Table 3. (Continued).

	• Sage-grouse habitat – *all ecological types* ○ Prioritize areas where restoration of sagebrush and/or perennial grasses is needed to create large patches of landscape cover of sagebrush or connect existing patches of sagebrush habitat. ○ Prioritize areas with adequate landscape cover of sagebrush where restoration of perennial grasses and forbs is needed. • Areas affected by anthropogenic activities that cause surface disturbance, invasion, and fragmentation. (e.g., road and utility corridors, urban expansion, OHV use, and mineral/energy projects) – *all ecological types.*
Objectives	• Increase soil stability and curtail dust. • Control/suppress invasive annual grasses and other invasive plants. • Increase landscape cover of sagebrush. • Increase perennial grasses and forbs and biological soil crusts where they naturally occur. • Reduce the risk of large fires that burn sage-grouse habitat.
Activities	• Use integrated strategies to control/suppress annual invasive grass and other annual invaders. • Establish and maintain fuel breaks or greenstrips in areas dominated by invasive annual grasses that are adjacent to areas with >25% landscape sagebrush cover and adequate perennial native grasses and forbs. • Seed perennial grasses and forbs that are adapted to local conditions to increase cover of these species in areas where they are depleted. • Seed and/or transplant sagebrush to restore large patches of sagebrush cover and connect existing patches. • Repeat restoration treatments if they fail initially to ensure restoration success especially in warm and dry soil temperature moisture regimes where weather is often problematic for establishment. • Actively manage restored/rehabilitated areas to increase perennial herbaceous species and minimize secondary weed invasion.

Monitoring and Adaptive Management– implement comprehensive monitoring to track landscape change and management outcomes and provide the basis for adaptive management

Priorities	• Regional environmental gradients to track changes in plant community and other ecosystem attributes and expansion or contraction of species ranges – *all ecological types.* • Assess treatment effectiveness – *all ecological types.*
Objectives	• Understand effects of wildfire, annual grass invasion, piñon and juniper expansion, climate change and other global stressors in sagebrush ecosystems • Increase understanding of the long- and short-term outcomes of management treatments.
Activities	• Establish a regional network of monitoring sites that includes major environmental gradients. • Collect pre- and post-treatment monitoring data for all major land treatments activities. • Collect data on ecosystem status and trends (for example, land cover type, ground cover, vegetation cover and height [native and invasive], phase of tree expansion, soil and site stability, oddities). • Use consistent methods to monitor indicators. • Use a cross-boundary approach that involves all major land owners. • Use a common data base for all monitoring results (e.g., Land Treatment Digital Library; http://greatbasin.wr.usgs.gov/ltdl/). • Develop monitoring products that track change and provide management implications and adaptations for future management. • Support and improve information sharing on treatment effectiveness and monitoring results across jurisdictional boundaries (e.g., Great Basin Fire Science Delivery Project; www.gbfiresci.org).

Table 4. Specific management strategies by agency program area for the cells within the sage-grouse habitat matrix (table 2). The rows indicate relative resilience and resistance (numbers) and the columns indicate landscape cover of sagebrush by category (letters). Resilience and resistance are based on soil temperature and moisture regimes (fig. 11) and their relationship to ecological types (table 1). Percentage of the landscape dominated by sagebrush is based on the capacity of large landscapes to support viable sage-grouse populations over the long term (fig. 8). Note that these guidelines are related to the sage-grouse habitat matrix, and do not preclude other factors from consideration when determining management priorities for program areas. The "Fire Operations" program area includes preparedness, prevention, and suppression activities.

High Resilience to Disturbance and Resistance to Invasive Annual Grasses (1A, 1B, 1C)

Natural sagebrush recovery is likely to occur. Perennial herbaceous species are sufficient for recovery. Risk of invasive annual grasses is typically low.

Fire Operations	• Fire suppression is typically third order priority, but varies with large fire risk and landscape condition (cells 1A, 1B, 1C). Scenarios requiring higher priority may include: ○ Areas of sagebrush that bridge large, contiguous expanses of sagebrush and that are important for providing connectivity for sage-grouse (cells 1B, 1C). ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 1A, 1B, 1C) ○ Areas with later phase (Phase III) post-settlement piñon and juniper that have high resistance to control, are subject to large and/or severe fires, and place adjacent sage-grouse habitat at risk (cells 1A, 1B). ○ All areas when critical burning environment conditions exist. These conditions may be identified by a number of products including, but not limited to: Predictive Services 7-Day Significant Fire Potential Forecasts; National Weather Service Fire Weather Watches and Red Flag Warnings; fire behavior forecasts or other local knowledge.
Fuels Management	• Fuels management to reduce large sagebrush stand losses is a second order priority, especially in cells 1B and 1C. Management activities include: ○ Strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Tree removal in early to mid-phase (Phases I, II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads. ○ Tree removal in later phase (Phase III), post-settlement piñon and juniper areas to reduce risks of large or high severity fires. Because these areas represent non-sage-grouse habitat, prescribed fire may be appropriate on cool and moist sites, but invasive plant control and restoration of sagebrush and perennial native grasses and forbs may be necessary.
Post-Fire Rehabilitation	• Post-fire rehabilitation is generally low priority (cells 1A, 1B, 1C). Areas of higher priority include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Steep slopes and soils with erosion potential.
Habitat Restoration and Recovery	• Restoration is typically passive and designed to increase or maintain perennial herbaceous species, biological soil crusts and landscape cover of sagebrush (cells 1A, 1B, 1C). Areas to consider for active restoration include: ○ Areas where perennial herbaceous cover density, or composition is inadequate for recovery after surface disturbance. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse.

Moderate Resilience to Disturbance and Resistance to Invasive Annuals (2A, 2B, 2C)

Natural sagebrush recovery is likely to occur on cooler and moister sites, but the time required may be too great if large, contiguous areas lack sagebrush. Perennial herbaceous species are usually adequate for recovery on cooler and moister sites. Risk of invasive annual grasses is moderately high on warmer and drier sites.

Fire Operations	• Fire suppression is typically second order priority (cells 2A, 2B, 2C). Scenarios requiring higher priority may include: ○ Areas of sagebrush that bridge large, contiguous expanses of sagebrush and that are important for providing connectivity for sage-grouse (cells 2B, 2C).

(continued)

Table 4. (Continued).

	○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 2A, 2B, 2C) ○ Areas with later phase (Phase III), post-settlement piñon and juniper that have high resistance to control, are subject to large and/or severe fires, and place adjacent sage-grouse habitat at risk (cells 2A, 2B). ○ Areas where annual grasslands place adjacent sage-grouse habitat at risk (cell 2A). ○ All areas when critical burning environment conditions exist. These conditions may be identified by a number of products including, but not limited to: Predictive Services 7-Day Significant Fire Potential Forecasts; National Weather Service Fire Weather Watches and Red Flag Warnings; fire behavior forecasts or other local knowledge.
Fuels Management	• Fuels management to reduce large sagebrush stand losses is a first order priority, especially in cells 2B and 2C. Management activities include: ○ Strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Tree removal in early to mid-phase (Phase I, II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads. ○ Tree removal in later phase (Phase III), post-settlement piñon and juniper areas to reduce risks of large or high severity fires. Because these areas represent non-sage-grouse habitat, prescribed fire may be appropriate on cool and moist sites, but restoration of sagebrush and perennial native grasses and forbs may be necessary.
Post-Fire Rehabilitation	• Post-fire rehabilitation is generally low priority (cells 2A, 2B, 2C) in cooler and moister areas. Areas of higher priority include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Relatively warm and dry areas where annual invasives are expanding. ○ Steep slopes with erosion potential.
Habitat Restoration and Recovery	• Restoration is typically passive on cooler and moister areas and is designed to increase or maintain perennial herbaceous species, biological soil crusts, and landscape cover of sagebrush (cells 2A, 2B, 2C). Areas to consider for active restoration include: ○ Areas where perennial herbaceous cover, density, and species composition is inadequate for recovery after surface disturbance. ○ Areas where seeding or transplanting sagebrush is needed to maintain habitat connectivity for sage-grouse. ○ Relatively warm and dry areas where annual invasives are expanding.

Low Resilience to Disturbance and Resistance to Invasive Annuals (3A, 3B, 3C)

Natural sagebrush recovery is not likely. Perennial herbaceous species are typically inadequate for recovery. Risk of invasive annual grasses is high.

Fire Operations	• Fire suppression priority depends on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). These areas may be a higher priority if they are adjacent to intact sage-grouse habitat or are essential for connectivity. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). These areas are higher priority if they have intact understories and if they are adjacent to sage-grouse habitat. ○ Areas with >65% landscape cover of sagebrush are first order priority (cell 3C). ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 3A, 3B, 3C).

(continued)

Table 4. (Continued).

Fuels Management	• Fuels management priority and management activities depend on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). Strategic placement of fuel breaks may be needed to reduce loss of adjacent sage-grouse habitat by wildfire. Examples include linear features or other strategically placed treatments that serve to constrain fire spread or otherwise augment suppression efforts. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). These areas are higher priority if they have intact understories and if they are adjacent to sage-grouse habitat. Strategic placement of fuel breaks may be needed to reduce loss of large sagebrush stands by wildfire. ○ Areas with >65% landscape cover of sagebrush are first order priority (cell 3C). Strategic placement of fuel breaks may be needed to reduce loss of large sagebrush stands by wildfire. ○ Areas where sagebrush communities have been successfully reestablished through seedings or other rehabilitation investments (cells 3A, 3B, 3C). Strategic placement of fuel breaks may be needed to protect investments from repeated loss to wildfire.
Post-Fire Rehabilitation	• Post-fire rehabilitation priority and management activities depend on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority (cell 3A). Exceptions include (1) sites that are relatively cool and moist and (2) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. In highly invaded areas, integrated strategies that include seeding of perennial herbaceous species and seeding and/or transplanting sagebrush will be required. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). Exceptions include (1) sites that are relatively cool and moist or that are not highly invaded, and (2) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. Seeding of perennial herbaceous species will be required where cover, density and species composition of these species is inadequate for recovery. Seeding and/or transplanting sagebrush as soon as possible is necessary for rehabilitating sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with >65% landscape cover of sagebrush are first order priority, especially if they are part of a larger, contiguous area of sagebrush (cell 3C). Seeding of perennial herbaceous species will be required where cover, density and species composition of these species is inadequate for recovery. Seeding and/or transplanting sagebrush as soon as possible is necessary for rehabilitating sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation.
Habitat Restoration and Recovery	• Restoration priority and management activities depends on the landscape cover of sagebrush: ○ Areas with <25% landscape cover of sagebrush are typically third order priority. Exceptions include (1) surface disturbances and (2) areas adjacent to sage-grouse habitat where seeding can be used to prevent annual invasive spread (cell 3A). In highly invaded areas, integrated strategies that include seeding of perennial herbaceous species and seeding and/or transplanting sagebrush will be required. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with 26-65% landscape cover of sagebrush are typically second order priority (cell 3B). Exceptions include (1) surface disturbances, (2) sites that are relatively cool and moist or that are not highly invaded, and (3) areas adjacent to sage-grouse habitat where seeding can be used to increase connectivity and prevent annual invasive spread. Seeding of perennial herbaceous species may be required where cover, density and species composition of these species is inadequate. Seeding and/or transplanting sagebrush as soon as possible is necessary for restoring sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation. ○ Areas with >65% landscape cover of sagebrush are first order priority, especially if they are part of a larger, contiguous area of sagebrush (cell 3C). Seeding of perennial herbaceous species may be required where cover, density, and species composition of these species is inadequate. Seeding and/or transplanting sagebrush as soon as possible is necessary for restoring sage-grouse habitat. Success will likely require more than one intervention due to low and variable precipitation.

Another important consideration is that ecological processes such as wildfire can occur either within or across categories in the sage-grouse habitat matrix and it is necessary to determine the appropriate spatial context when evaluating management opportunities based on resilience and resistance and sage-grouse habitat. For example, if critical sage-grouse habitat occurs in close proximity to landscapes comprised mainly of annual grass-dominated plant communities, then fire risk to adjacent sage-grouse habitat can increase dramatically (Balch et al. 2013). In this scenario, management actions could include reducing the influence of invasive annual grasses with a strategic fuel break on the perimeter of intact sagebrush. Thus, management actions may have value to sustaining existing sage-grouse habitat, even if these measures are applied in locations that are currently not habitat; the spatial relationships of sagebrush and invasive annual grasses should be considered when prioritizing management actions and associated conservation measures.

Informing Wildfire and Fuels Management Strategies to Conserve Sage-Grouse

Collectively, responses to wildfires and implementation of fuels management projects are important contributors to sage-grouse conservation. Resilience and resistance concepts provide a science-based background that can inform fire operations and fuels management strategies and allocation of scarce assets during periods of high fire activity. In fire operations, firefighter and public safety is the overriding objective in all decisions. In addition, land managers consider numerous other values at risk, including the Wildland-Urban Interface (WUI), habitats, and infrastructure when allocating assets and prioritizing efforts. Resilience and resistance concepts are especially relevant for evaluating tradeoffs related to current ecological conditions and rates of recovery and possible ecological consequences of different fire management activities. For example, prioritizing initial attack efforts based on ecological types and their resilience and resistance at fire locations is a possible future application of resilience and resistance concepts. Also, fire prevention efforts can be concentrated where human ignitions have commonly occurred near intact, high quality habitats that also have inherently low resilience and resistance.

Fuels management projects are often applied to (1) constrain or minimize fire spread; (2) alter species composition; (3) modify fire intensity, severity, or effects; or (4) create fuel breaks or anchor points that augment fire management efforts (fig. 13). These activities are selectively used based on the projected ecosystem response, anticipated fire patterns, and probability of success. For example, in areas that are difficult to restore due to low to moderate resilience, fuel treatments can be placed to minimize fire spread and conserve sagebrush habitat. In cooler and moister areas with moderate to high resilience and resistance, mechanical or prescribed fire treatments may be appropriate to prevent conifer expansion and dominance. Given projected climate change and longer fire seasons across the western United States, fuels management represents a proactive approach for modifying large fire trends. Fire operations and fuels management programs contribute to a strategic, landscape approach when coupled with data that illustrate the likelihood of fire occurrence, potential fire behavior, and risk assessments (Finney et al. 2010; Oregon Department of Forestry 2013). In tandem with resilience and resistance concepts, these data can further inform fire operations and fuels management decisions.

Figure 13. Fuel breaks may include roads, natural features, or other management imposed treatments intended to modify fire behavior or otherwise augment suppression efforts at the time of a fire. Such changes in fuel type and arrangement may improve suppression effectiveness by modifying flame length and fire intensity, and allow fire operations to be conducted more safely. The top photo shows a burnout operation along an existing road to remove available fuels ahead of an oncoming fire and constrain overall fire growth (photo by BLM Idaho Falls District). The bottom photo shows fuel breaks located along a road, which complimented fire control efforts when a fire intersected the fuel break and road from the right (photo by Ben Dyer, BLM).

Putting it all Together

Effective management and restoration of sage-grouse habitat will benefit from a collaborative approach that prioritizes the best management practices in the most appropriate places. This section describes an approach for assessing focal areas for sage-grouse habitat management based on widely available data, including (1) Priority Areas for Conservation (PACs), (2) breeding bird densities, (3) habitat suitability as indicated by the landscape cover of sagebrush, (4) resilience and resistance and dominant ecological types as indicated by soil temperature and moisture regimes, and (5) habitat threats as indicated by cover of cheatgrass, cover of piñon and juniper, and by fire history. Breeding bird density data are overlain with landscape cover of sagebrush and with resilience and resistance to spatially link sage-grouse populations with habitat conditions and risks. We illustrate the use of this step-down approach for evaluating focal areas for sage-grouse habitat management across the western portion of the range, and we provide a detailed example for a diverse area in the northeast corner of Nevada that is comprised largely of PACs with mixed land ownership. The sage-grouse habitat matrix (table 2) is used as a tool in the decision process, and guidelines are provided to assist in determining appropriate management strategies for the primary agency program areas (fire operations, fuels management, post-fire rehabilitation, habitat restoration) for each cell of the matrix.

We conclude with discussions of the tools available to aid in determining the suitability of an area for treatment and the most appropriate management treatments such as ecological site descriptions and state and transition models and of monitoring and adaptive management. Datasets used to compile the maps in the following sections are in Appendix 4.

Assessing Focal Areas for Sage-Grouse Habitat Management: Key Data Layers

Priority areas for conservation: The recent identification of sage-grouse strongholds, or Priority Areas for Conservation (PACs), greatly improves the ability to target management actions towards habitats expected to be critical for long-term viability of the species (fig. 14; USFWS 2013). Understanding and minimizing risks of large-scale loss of sagebrush and conversion to invasive annual grasses or piñon and juniper in and around PACs will be integral to maintaining sage-grouse distribution and stabilizing population trends. PACs were developed by individual states to identify those areas that are critical for ensuring adequate representation, redundance, and resilience to conserve sage-grouse populations. Methods differed among states; in general, PAC boundaries were identified based on (1) sage-grouse population data including breeding bird density, lek counts, telemetry, nesting areas, known distributions, and sightings/observations; and (2) habitat data including occupied habitat, suitable habitat, seasonal habitat, nesting and brood rearing areas, and connectivity areas or corridors. Sage-grouse habitats outside of PACs also are important in assessing focal areas for management where they provide connectivity between PACs (genetic and habitat linkages), seasonal habitats that may have been underestimated due to emphasis on lek sites to define priority areas, habitat restoration and population expansion opportunities, and flexibility for managing habitat changes that may result from climate change (USFWS 2013). If PAC boundaries are adjusted, they will need to be updated for future analyses.

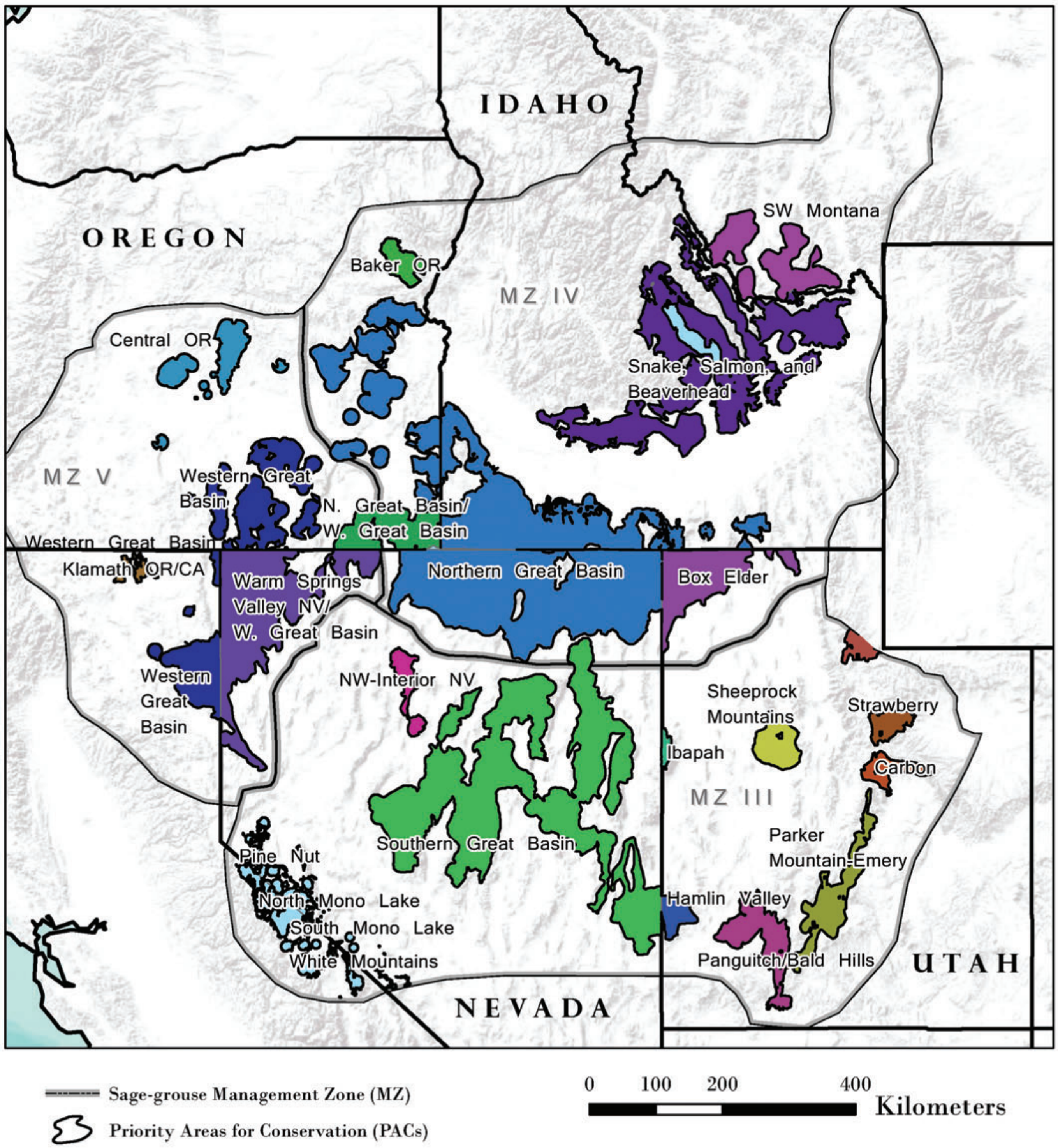

Figure 14. Priority Areas for Conservation (PACs) within the range of sage-grouse (USFWS 2013). Colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Breeding bird density: Range-wide breeding bird density areas provide one of the few accessible data sets for further prioritizing actions within and adjacent to PACs to maintain species distribution and abundance. Doherty et al. (2010b) developed a useful framework for incorporating population data in their range-wide breeding bird density analysis, which used maximum counts of males on leks (n = 4,885) to delineate breeding bird density areas that contain 25, 50, 75, and 100% of the known breeding population (fig. 15). Leks were mapped according to these abundance values and buffered by a 6.4 to 8.5 km (4.0 to 5.3 mi) radius to delineate nesting areas. Findings showed that while sage-grouse occupy extremely large landscapes, their breeding distribution is highly aggregated in comparably smaller identifiable population centers; 25% of the known population occurs within 3.9% (2.9 million ha; 7.2 million ac) of the species range, and 75% of birds are within 27.0% of the species range (20.4 million ha; 50.4 million ac) (Doherty et al. 2010b). The Doherty et al. (2010b) analysis emphasized breeding habitats primarily because little broad scale data exist for summer and winter habitat use areas. Even though the current breeding bird density data provide the most comprehensive data available, they do not include all existing sage-grouse populations. Incorporating finer scale seasonal habitat use data at local levels where it is available will ensure management actions encompass all seasonal habitat requirements.

For this assessment, we chose to use State-level breeding bird density results from Doherty et al. (2010b) instead of range-wide model results to ensure that important breeding areas in MZs III, IV, and V were not underweighted due to relatively higher bird densities in the eastern portion of the range. It is important to note that breeding density areas were identified using best available information in 2009, so these range-wide data do not reflect the most current lek count information or changes in conditions since the original analysis. Also, breeding density areas should not be viewed as rigid boundaries but rather as the means to prioritize landscapes regionally where step-down assessments and actions may be implemented quickly to conserve the most birds.

Landscape cover of sagebrush: Landscape cover of sagebrush is one of the key determinants of sage-grouse population persistence and, in combination with an understanding of resilience to disturbance and resistance to invasive annuals, provides essential information both for determining priority areas for management and appropriate management actions (fig. 10; tables 2 and 3). Landscape cover of sagebrush is a measure of large, contiguous patches of sagebrush on the landscape and is calculated from remote sensing databases such as LANDFIRE (see Appendix 4). We used the three cover categories of sagebrush landscape cover discussed previously to predict the likelihood of sustaining sage-grouse populations (1-25%, 25-65%, >65%). The sagebrush landscape cover datasets were created using a moving window to summarize the proportion of area (5-km [3.1-mi] radius) dominated by sagebrush surrounding each 30-m pixel and then assigned those areas to the three categories (see Appendix 2). Because available sagebrush cover from sources such as LANDFIRE does not exclude recent fire perimeters, it was necessary to either include these in the analysis of landscape cover of sagebrush or display them separately. Although areas that have burned since 2000 likely do not currently provide desired sage-grouse habitat, areas with the potential to support sagebrush ecological types can provide conservation benefits in the overall planning effort especially within long-term conservation areas like PACs. The landscape cover of sagebrush and recent fire perimeters are illustrated for the western portion of the range (fig.16) and northeast Nevada (fig. 17).

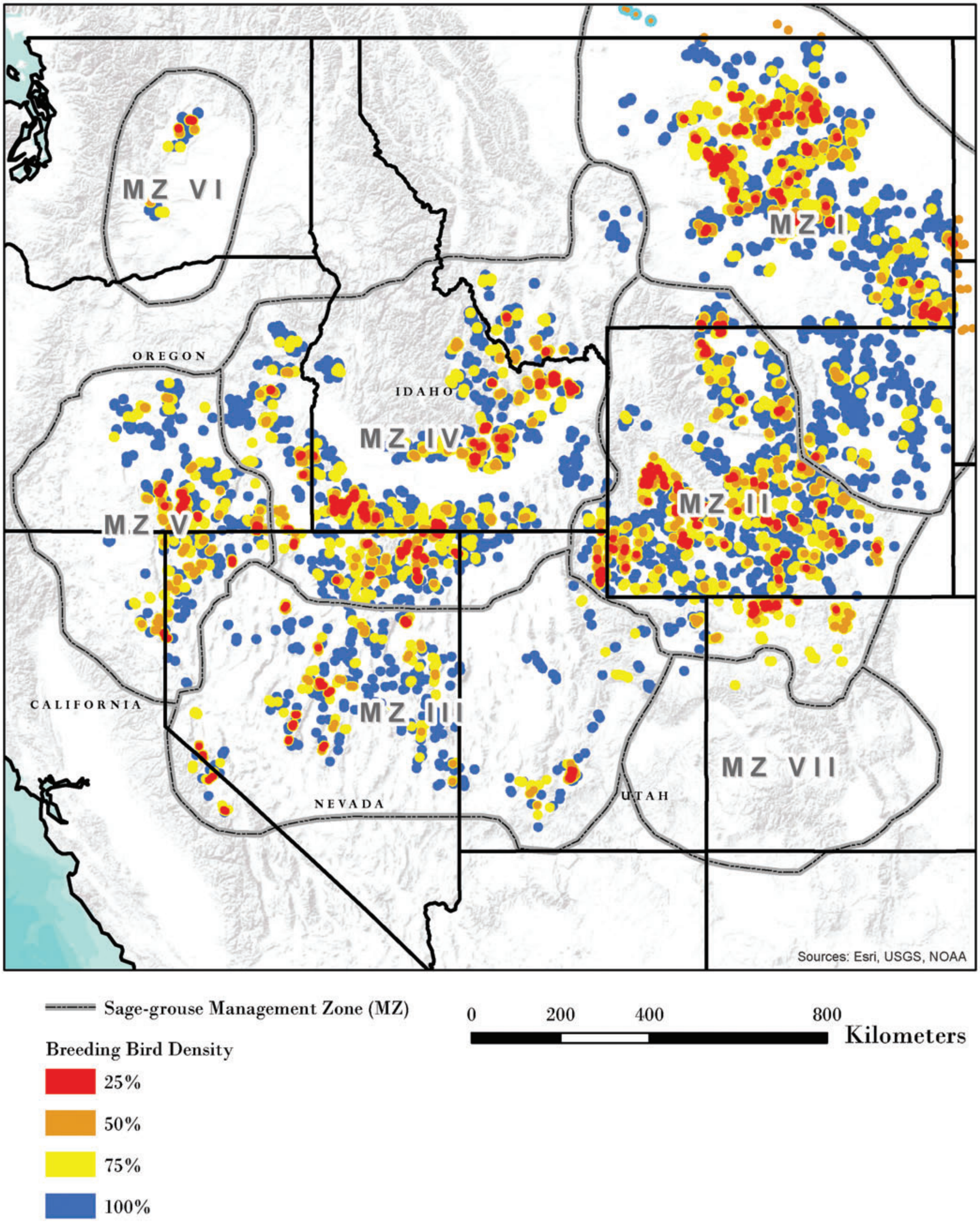

Figure 15. Range-wide sage-grouse breeding bird densities from Doherty et al. 2010. Points illustrate breeding bird density areas that contain 25, 50, 75, and 100% of the known breeding population and are based on maximum counts of males on leks (n = 4,885). Leks were mapped according to abundance values and buffered by 6.4 to 8.5 km (4.0 to 5.2 mi) to delineate nesting areas.

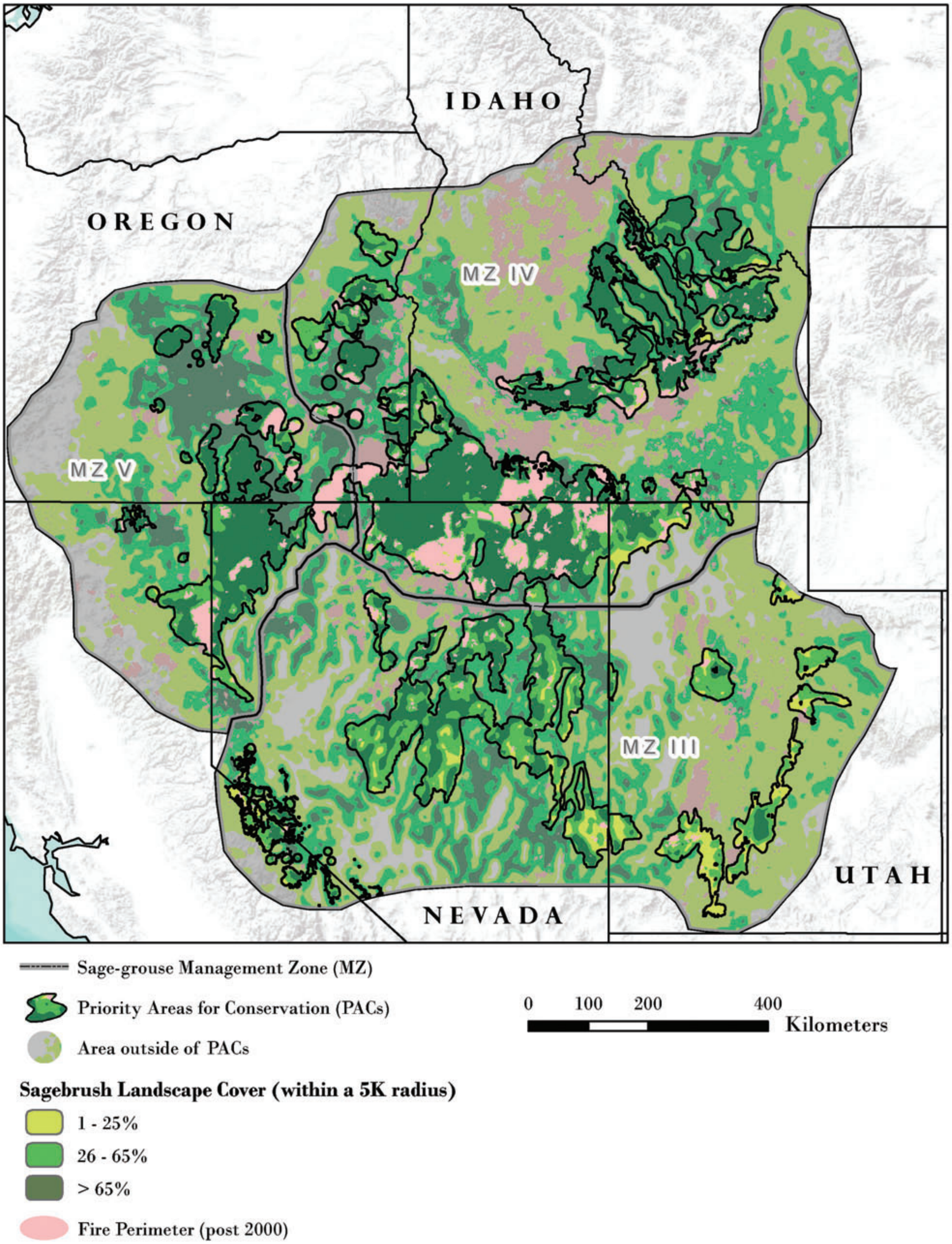

Figure 16. The landscape cover of sagebrush within each of three selected categories (1-25%, 26-65%, >65%) for Management Zones III, IV, and V (Stiver et al. 2006). The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover. Darker colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

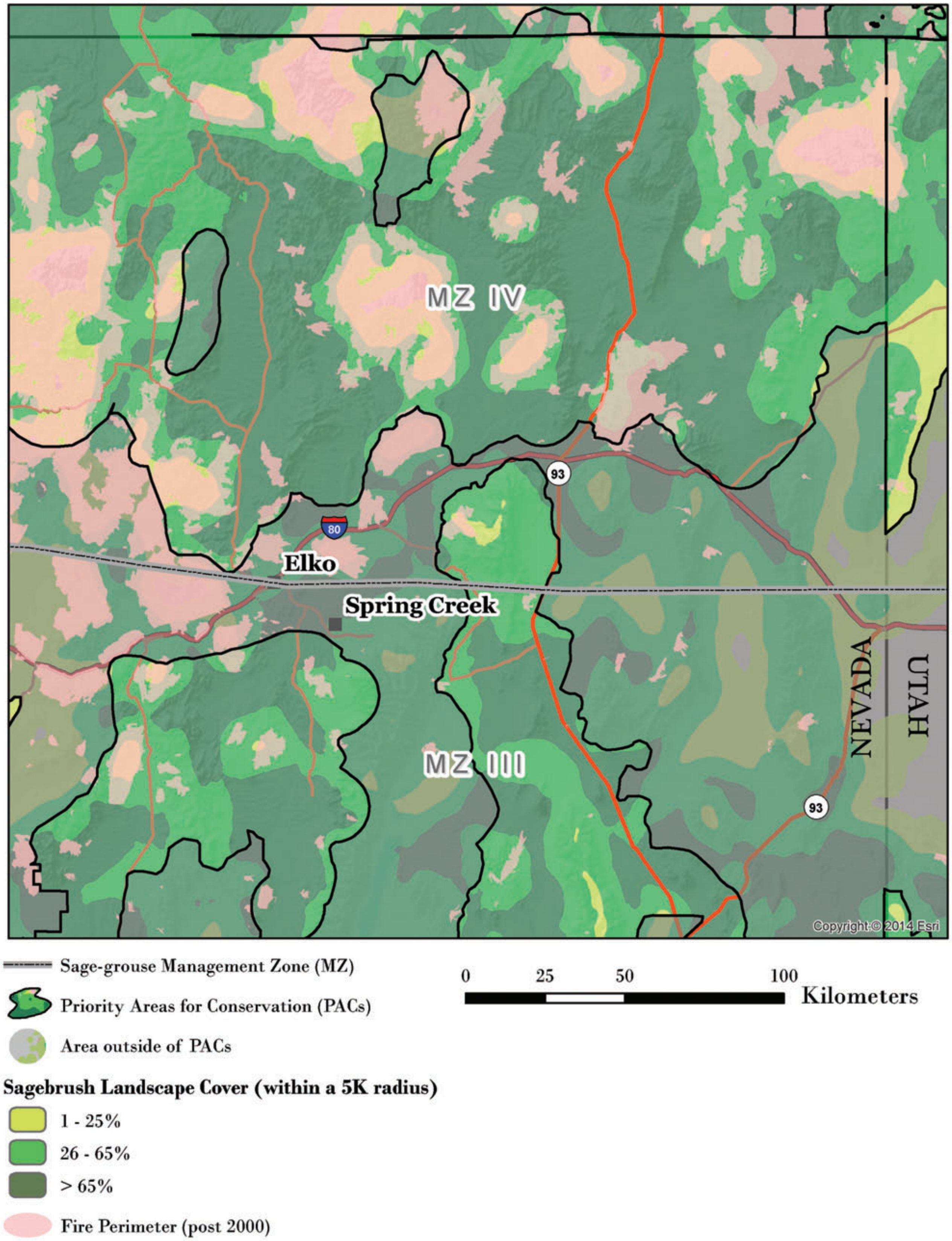

Figure 17. The landscape cover of sagebrush within each of the selected categories (1-25%, 26-65%, >65%) for the northeastern portion of Nevada. The proportion of sagebrush (USGS 2013) within each of the categories in a 5-km (3.1-mi) radius surrounding each pixel was calculated relative to other land cover types for locations with sagebrush cover. Darker colored polygons delineate Priority Areas for Conservation (USFWS 2013).

Resilience to disturbance and resistance to annuals: Soil temperature and moisture regimes are a strong indicator of ecological types and of resilience to disturbance and resistance to invasive annual plants (fig. 11; table 1). Resilience and resistance predictions coupled with landscape cover of sagebrush can provide critical information for determining focal areas for targeted management actions (tables 2, 3, and 4). The available data for the soil temperature and moisture regimes were recently compiled to predict resilience and resistance (see Appendix 3). These data, displayed for the western portion of the range and northeast Nevada (figs. 18 and 19), illustrate the spatial variability within the focal areas. Soil temperature and moisture regimes are two of the primary determinants of ecological types and of more detailed ecological site descriptions, which are described in the section on "Determining the Most Appropriate Management Treatments at the Project Scale."

Habitat threats: Examining additional land cover data or models of invasive annual grasses and piñon and/or juniper, can provide insights into the current extent of threats in a planning area (e.g., Manier et al. 2013). In addition, evaluating data on fire occurrence and size can provide information on fire history and the rate and pattern of change within the planning area. Data layers for cheatgrass cover have been derived from Landsat imagery (Peterson 2006, 2007) and from model predictions based on species occurrence, climate variables, and anthropogenic disturbance (e.g., the Bureau of Land Management [BLM] Rapid Ecoregional Assessments [REAs]). The REAs contain a large amount of geospatial data that may be useful in providing landscape scale information on invasive species, disturbances, and vegetation types across most of the range of sage-grouse (http://www.blm.gov/wo/st/en/prog/more/Landscape_Approach/reas.html). Similarly, geospatial data for piñon and/or juniper have been developed for various States (e.g., Nevada and Oregon) and are becoming increasingly available rangewide. In addition, more refined data products are often available at local scales. Land managers can evaluate the available land cover datasets and select those land covers with the highest resolution and accuracy for the focal area. Land cover of cheatgrass and piñon and/or juniper and the fire history of the western portion of the range and northeast Nevada are in figures 20-25.

Assessing Focal Areas for Sage-Grouse Habitat Management: Integrating Data Layers

Combining resilience and resistance concepts with sage-grouse habitat and population data can help land managers further gauge relative risks across large landscapes and determine where to focus limited resources to conserve sage-grouse populations. Intersecting breeding bird density areas with soil temperature and moisture regimes provides a spatial tool to depict landscapes with high bird concentrations that may have a higher relative risk of being negatively affected by fire and annual grasses (figs. 26, 27). For prioritization purposes, areas supporting 75% of birds (6.4 to 8.5 km [4.0 to 5.2 mi] buffer around leks) can be categorized as high density while remaining breeding bird density areas (75-100% category; 8.5-km [5.2-mi] buffer around leks) can be categorized as low density. Similarly, warm and dry types can be categorized as having relatively low resilience to fire and resistance to invasive species and all other soil temperature and moisture regimes can be categorized as having relatively moderate to high resilience and resistance. Intersecting breeding bird density areas with landscape cover of sagebrush provides another spatial component revealing large and intact habitat blocks and areas in need of potential restoration to provide continued connectivity (fig. 28).

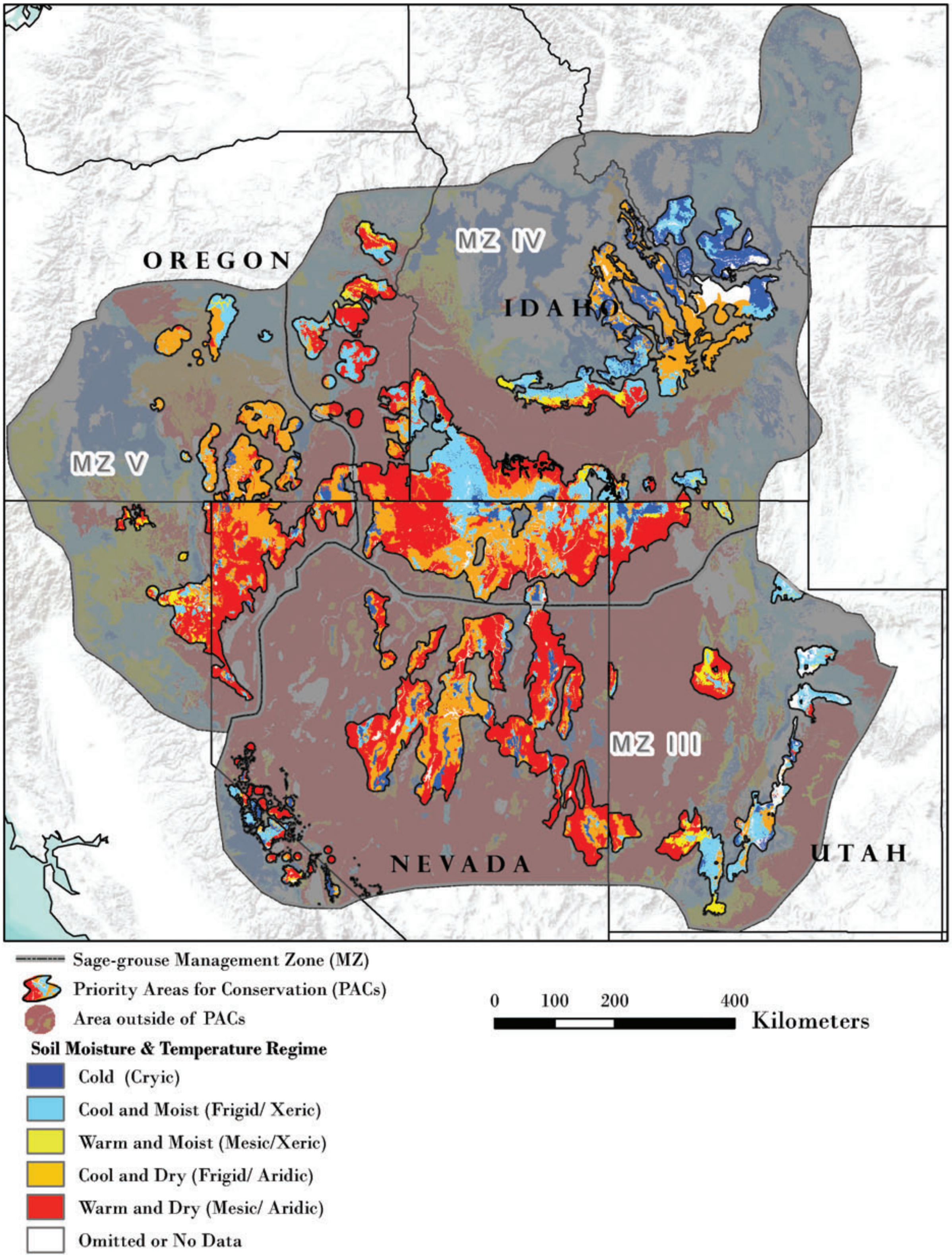

Figure 18. The soil temperature and moisture regimes within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b). Darker colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

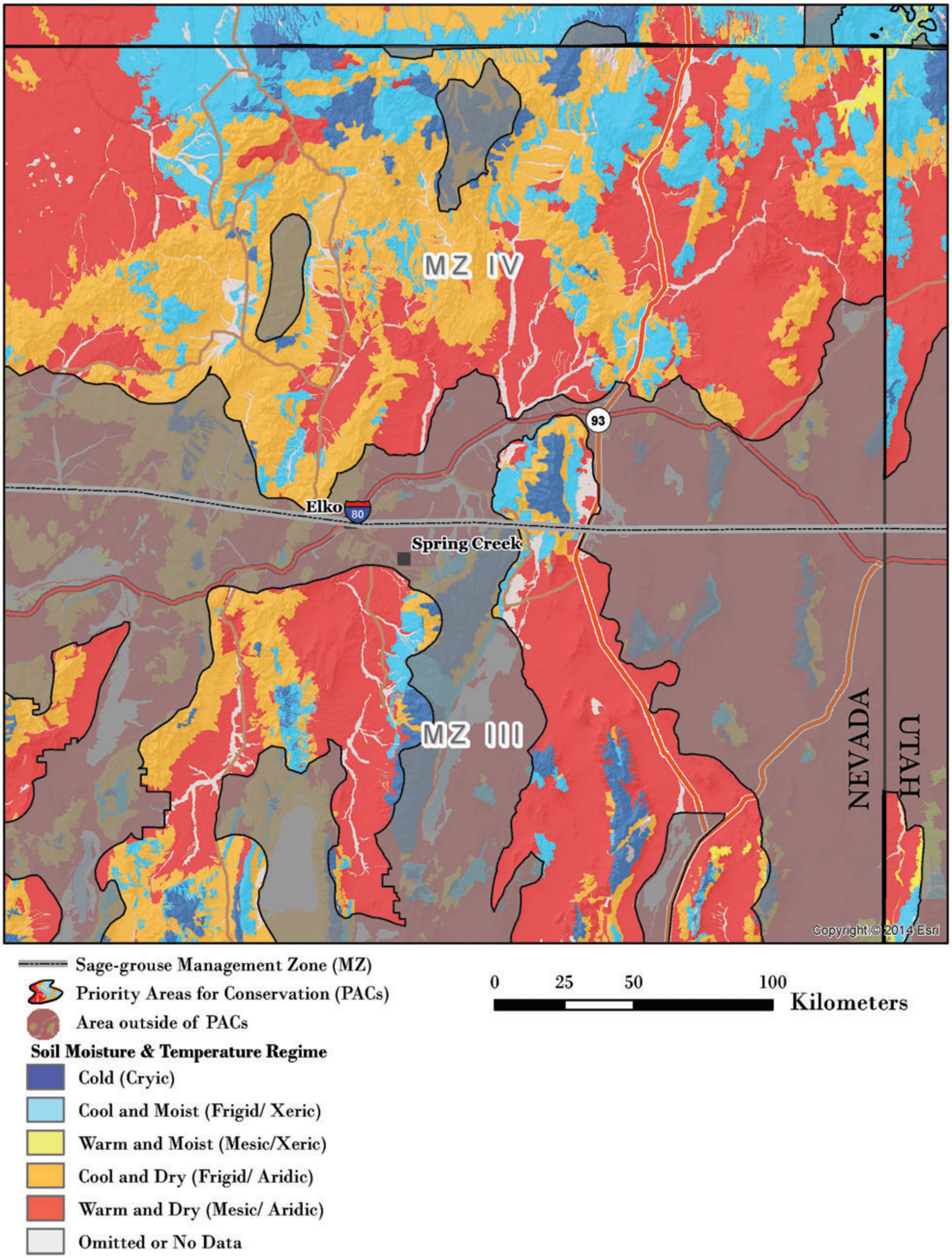

Figure 19. The soil temperature and moisture regimes for the northeast corner of Nevada. Soil temperature and moisture classes were derived from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (Soil Survey Staff 2014a). Gaps in that dataset were filled in with the NRCS State Soil Geographic Database (STATSGO) (Soil Survey Staff 2014b). Darker colored polygons delineate Priority Areas for Conservation (USFWS 2013).

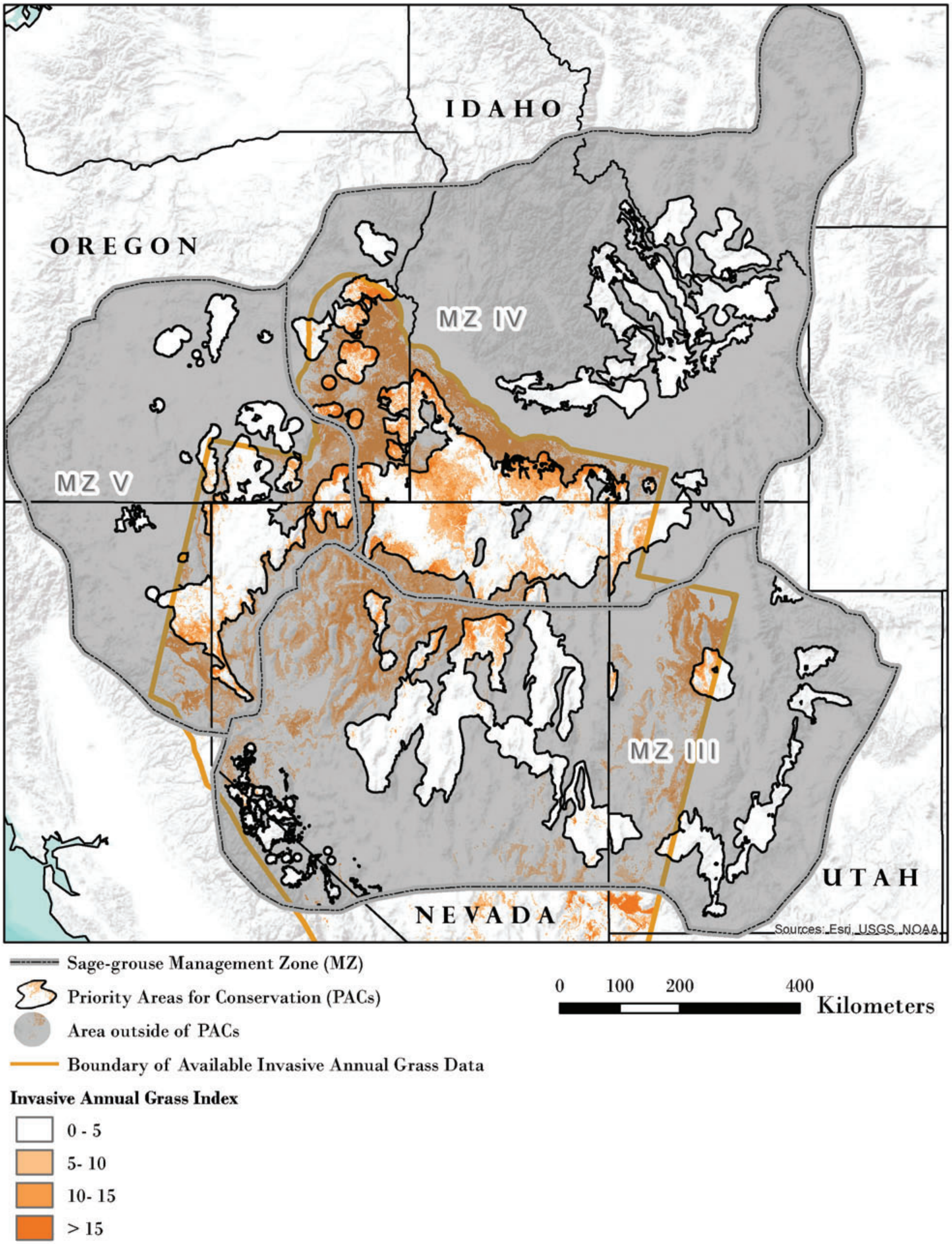

Figure 20. Invasive annual grass index for Nevada (Peterson 2006) and the Owhyee uplands (Peterson 2007) displayed for sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

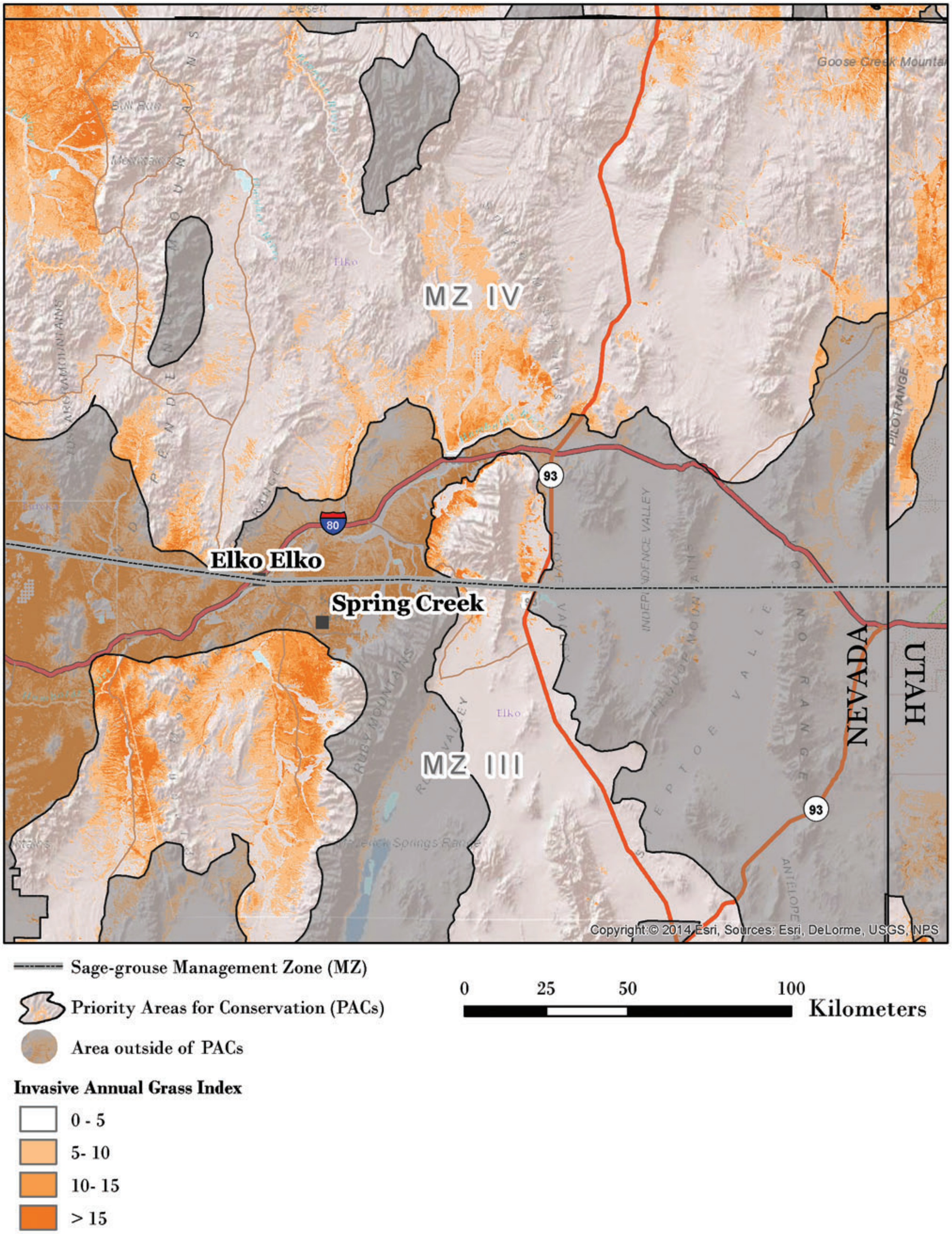

Figure 21. Invasive annual grass index for Nevada (Peterson 2006) and the Owhyee uplands (Peterson 2007) displayed for the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

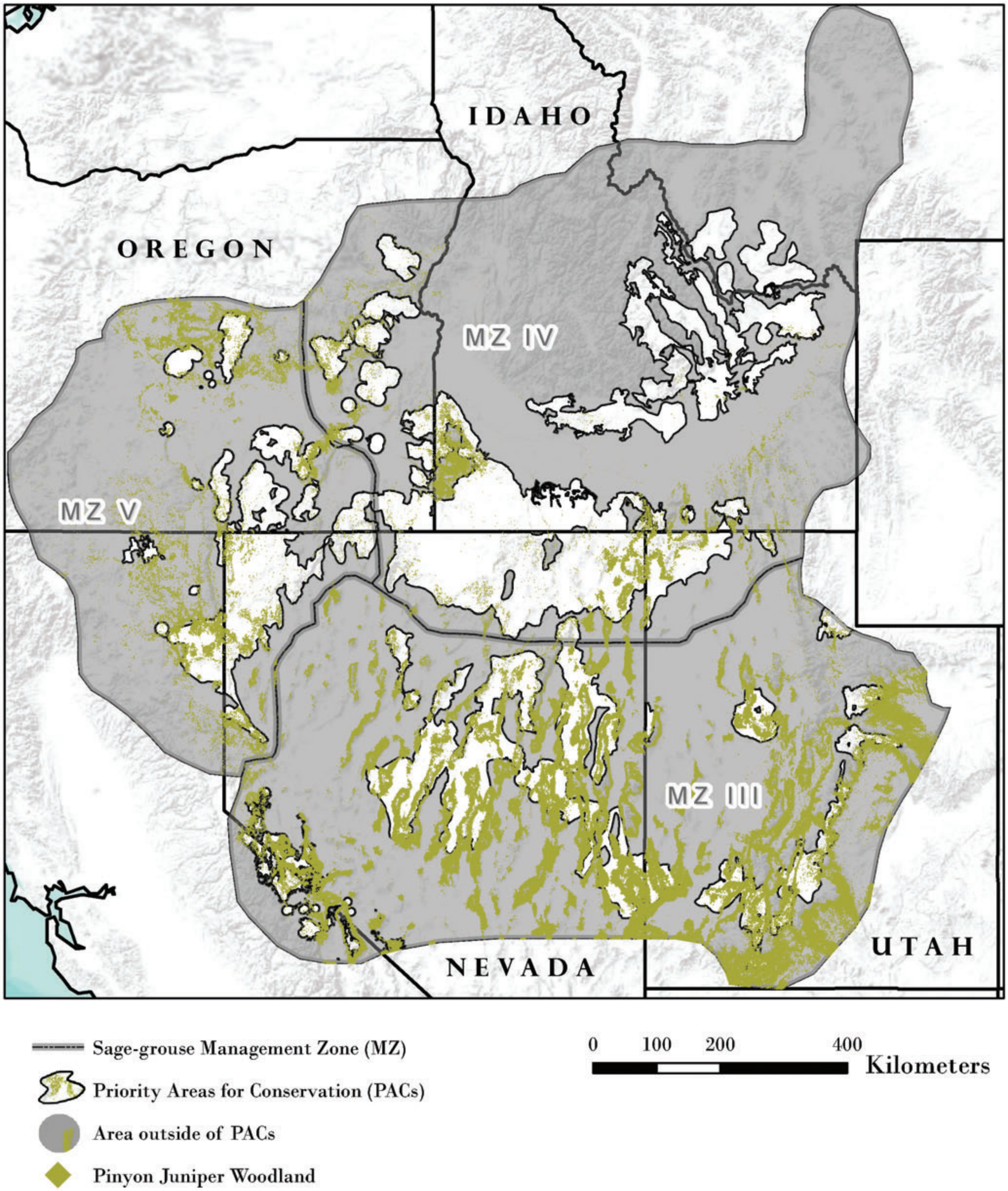

Figure 22. Piñon and/or juniper woodlands (USGS 2004; USGS 2013) within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Figure 23. Piñon and/or juniper woodlands (USGS 2004; USGS 2013) within the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

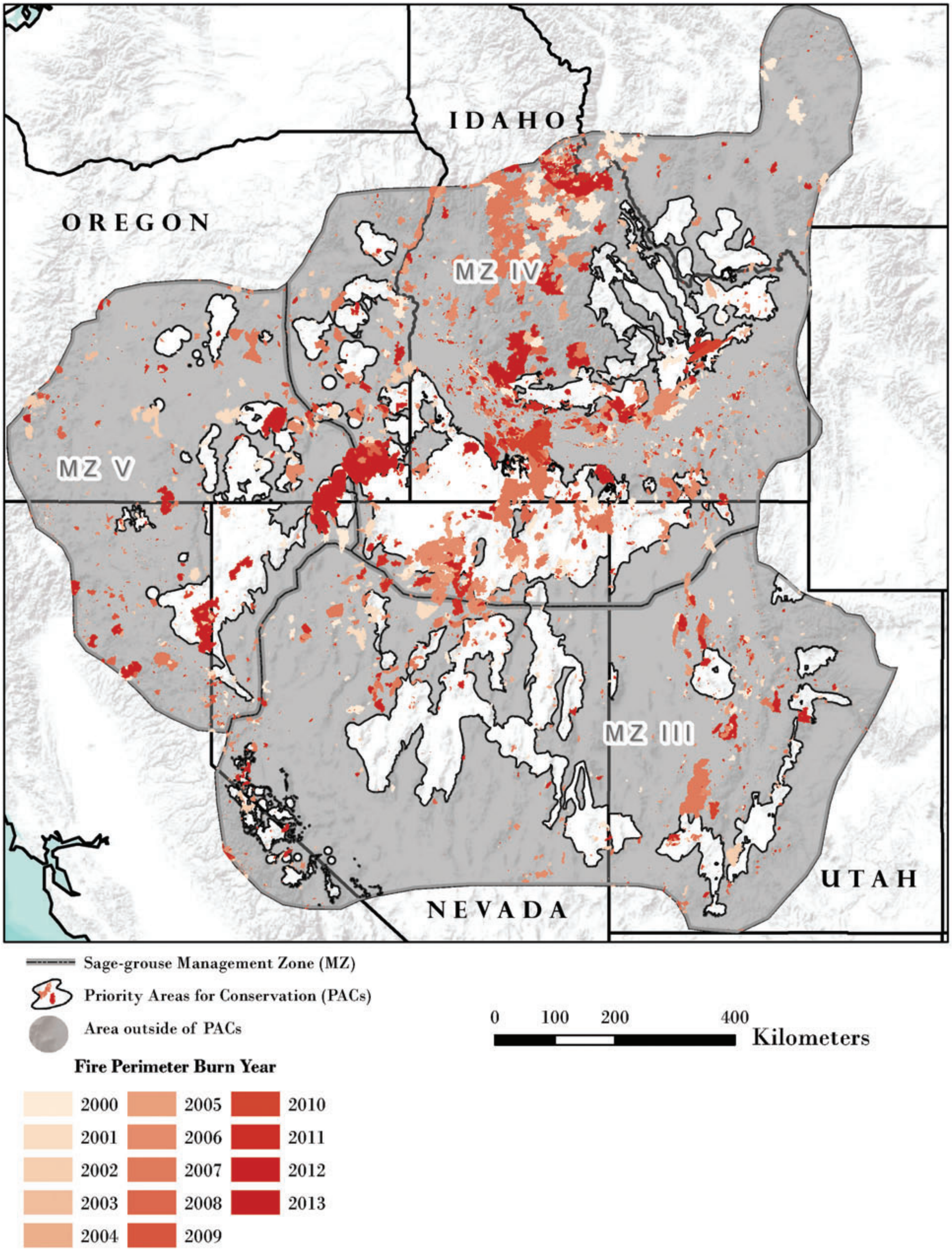

Figure 24. Fire perimeters (Walters et al. 2011; Butler and Bailey 2013) within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Ligher colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

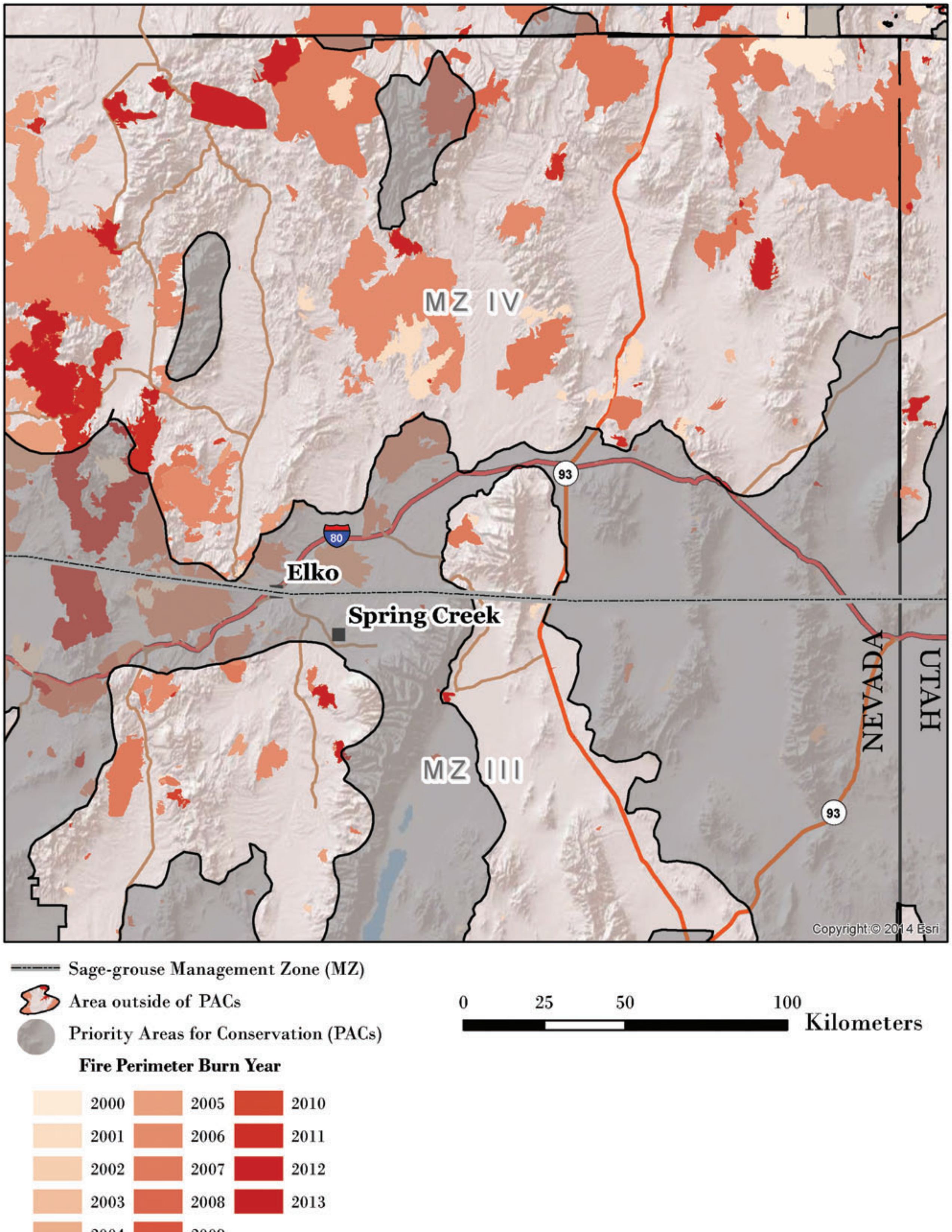

Figure 25. Fire perimeters (Walters et al. 2011; Butler and Bailey 2013) within the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

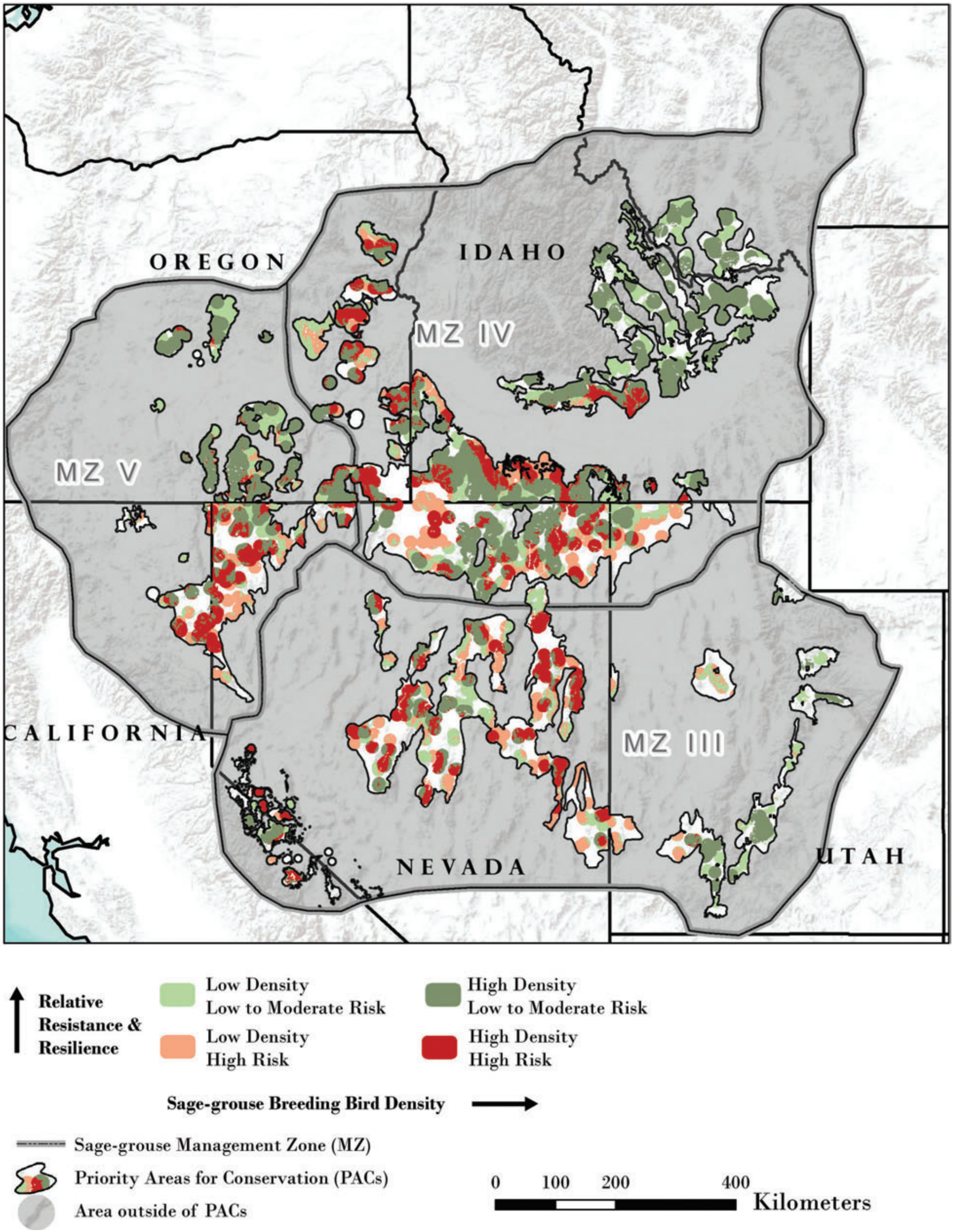

Figure 26. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to resilience and resistance within sage-grouse Management Zones III, IV, and V (Stiver et al. 2006). Relative resilience and resistance groups are derived from soil moisture and temperature classes (Soil Survey Staff 2014a, b) as described in text, and indicate risk of invasive annual grasses and wildfire. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

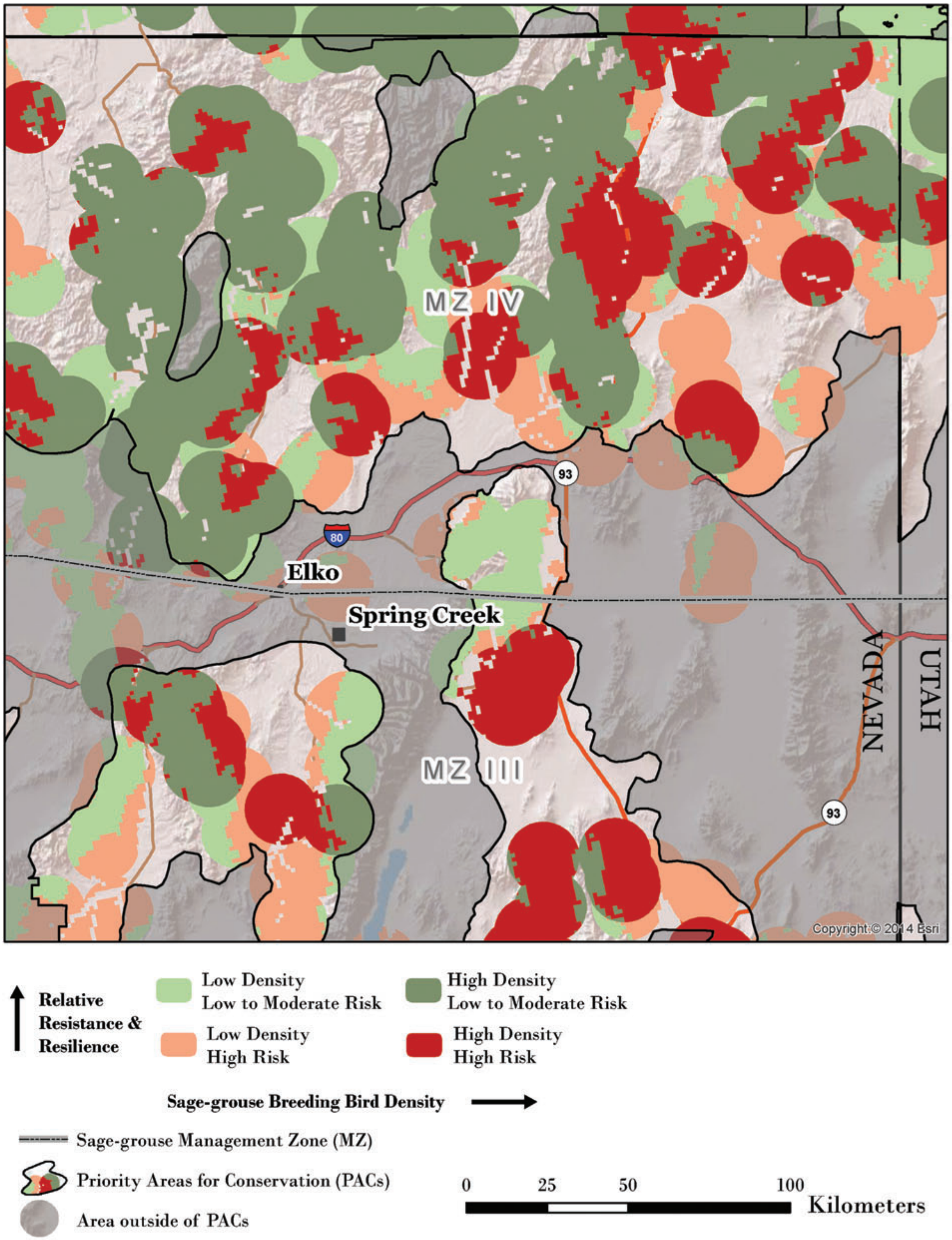

Figure 27. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to resilience and resistance in the northeast corner of Nevada. Relative resilience and resistance groups are derived from soil moisture and temperature classes (Soil Survey Staff 2014a, b) as described in text, and indicate risk of invasive annual grasses and wildfire. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

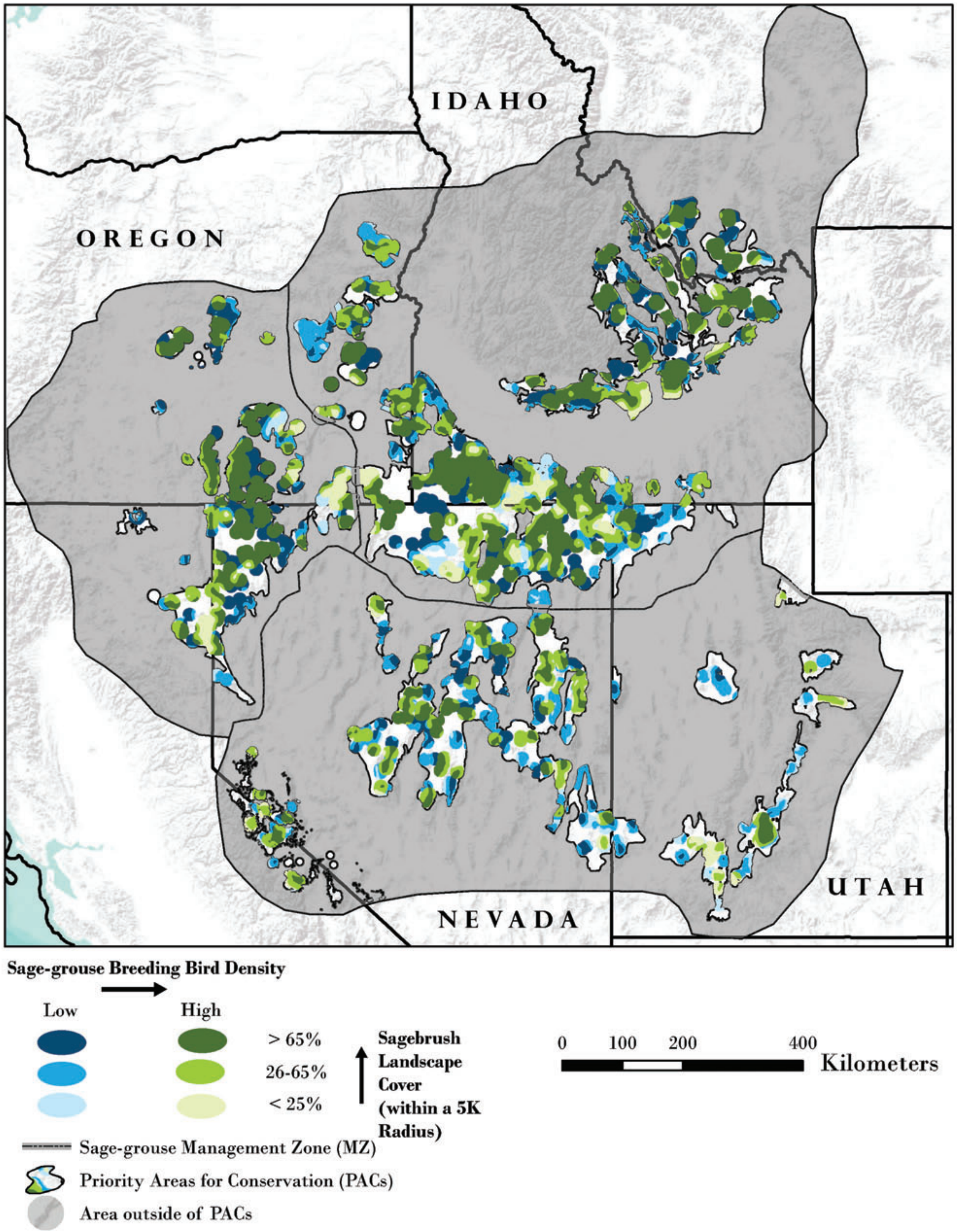

Figure 28. Sage-grouse breeding bird densities (Doherty et al. 2010) for high breeding bird densities (areas that contain 75% of known breeding bird populations) and low breeding bird densities (areas that contain all remaining breeding bird populations) relative to sagebrush cover. Lighter colored polygons within Management Zones delineate Priority Areas for Conservation (USFWS 2013).

Resilience and resistance and sagebrush cover combined with bird population density data provide land managers a way to evaluate trade-offs of particular management options at the landscape scale. For example, high density, low resilience and resistance landscapes with >65% sagebrush landscape cover may require immediate attention for conservation efforts because they currently support a high concentration of birds but have the lowest potential to recover to desired conditions post-fire and to resist invasive plants when disturbed. Similarly, high density but moderate-to-high resilience and resistance landscapes with 26-65% sagebrush cover may be priorities for preventative actions like conifer removal designed to increase the proportion of sagebrush cover and maintain ecosystem resilience and resistance. Mapping relative resilience and resistance and landscape cover of sagebrush for sage-grouse breeding areas should be viewed as a component of the assessment process that can help local managers allocate resources to accelerate planning and implementation.

Interpretations at the Management Zone (MZ) Scale: Western Portion of the Range

An examination of land cover and additional data layers for the western portion of the range reveals large differences among Management Zones (MZs) III, IV and V. MZs IV and V have larger areas with sagebrush cover >65% than MZ III (fig. 16). This may be partly explained by basin and range topography in MZ III, which is characterized by large differences in both environmental conditions and ecological types over relatively short distances. However, the cover of piñon and juniper in and adjacent to PACs in MZ III also is higher than in either MZ IV or V (fig. 22). The greater cover of piñon and juniper in MZ III appears to largely explain the smaller patches of sagebrush cover in the 26-65% and >65% categories.

Our capacity to quantify understory vegetation cover using remotely sensed data is currently limiting, but a visual examination of estimates for invasive annual grass (fig. 20; Peterson 2006, 2007) suggests a higher index (greater cover) in areas with relatively low resistance (warm soil temperatures) in all MZs (see fig. 18). This is consistent with current understanding of resistance to cheatgrass (Chambers et al. 2014; Chambers et al. *in press*). It is noteworthy that the invasive annual grass index is low for most of the central basin and range (central Nevada). Several factors may be contributing to the low index for this area including climate, the stage of piñon and juniper expansion and linked decrease in fire frequency, the relative lack of human development, and the relative lack of management treatments in recent decades (Wisdom et al. 2005; Miller et al. 2011). Not surprisingly, areas with a high annual grass index are outside or on the periphery of current PACs. However, it is likely that invasive annual grasses are present on many warmer sites and that they may increase following fire or other disturbances. In areas with low resistance to invasive annual grasses, they often exist in the understory of sagebrush ecosystems and are not detected by remote sensing platforms such as Landsat.

The number of hectares burned has been highest in MZ IV, adjacent areas in MZ V, and in areas with relatively low resilience and resistance in the northern portion of MZ III that have a high invasive annual grass index (figs. 18, 20, 24). A total of over 1.1 million hectares (2.7 million acres) burned in 2000 and 2006, while over 1.7 million hectares (4.2 million acres) burned in 2007 and 2012 and almost three quarters of these acres were in MZ IV (table 5). In some cases, these fires appear to be linked to the annual invasive grass index, but in others it clearly is not. At this point, there appears to be little relationship between cover of piñon and juniper and wildfire. Mega-fires comprised of hundreds of thousands of acres have burned in recent years, especially in MZ IV. These fires have occurred primarily in areas with low to moderate resilience and resistance and during periods with extreme burning conditions.

Table 5. The number of hectares (acres) burned in Management Zones III, IV, and V each year from 2000 to 2013.

Year	Management Zone III		Management Zone IV		Management Zone V		Total	
2000	155,159	(383,405)	868,118	(2,145,165)	88,871	(219,606)	1,112,148	(2,748,176)
2001	164,436	(406,330)	272,870	(674,276)	141,454	(349,541)	578,760	(1,430,147)
2002	85,969	(212,433)	100,308	(247,867)	113,555	(280,601)	299,833	(740,902)
2003	21,869	(54,038)	127,028	(313,892)	27,597	(68,192)	176,493	(436,123)
2004	20,477	(50,600)	11,344	(28,032)	13,037	(32,216)	44,858	(110,847)
2005	45,130	(111,520)	374,894	(926,382)	22,039	(54,458)	442,063	(1,092,360)
2006	198,762	(491,150)	860,368	(2,126,014)	117,452	(290,230)	1,176,582	(2,907,394)
2007	371,154	(917,140)	1,240,303	(3,064,853)	134,520	(332,406)	1,745,977	(4,314,399)
2008	14,015	(34,632)	109,151	(269,717)	43,949	(108,599)	167,115	(412,949)
2009	43,399	(107,242)	12,250	(30,271)	47,918	(118,408)	103,568	(255,921)
2010	31,597	(78,078)	280,662	(693,531)	21,940	(54,216)	334,200	(825,825)
2011	83,411	(206,114)	283,675	(700,977)	22,909	(56,608)	389,995	(963,699)
2012	203,680	(503,303)	946,514	(2,338,885)	574,308	(1,419,144)	1,724,501	(4,261,331)
2013	45,976	(113,610)	368,434	(910,419)	15,852	(39,170)	430,262	(1,063,199)
Total	1,485,034	(3,669,595)	5,855,920	(14,470,281)	1,385,400	(3,423,396)	8,726,354	(21,563,271)

Coupling breeding bird densities with landscape cover of sagebrush indicates that populations with low densities tend to occur in areas where sagebrush cover is in the 26-65% category, and few populations occur in areas with <25% sagebrush cover (fig. 27) (Knick et al. 2013). Combining the breeding bird densities with resilience and resistance indicates significant variability in risks among high density populations within PACs (fig. 26). A large proportion of remaining high density centers within PACs occurs on moderate-to-high resilience and resistance habitats, while low density/low resilience and resistance areas tend to occur along the periphery of PACs or are disproportionately located in MZ III and southern parts of MZ V.

Examination of other data layers suggests that different wildfire and invasive species threats exist across the western portion of the range, and that management should target the primary threats to sage-grouse habitat within focal areas. In MZs IV and V invasive annual grasses—especially on the periphery of the PACs—and wildfire are key threats. However, recent wildfires are not necessarily linked to invasive annual grasses. This suggests that management strategies for these MZs emphasize fire operations, fuels management focused on decreasing fire spread, and integrated strategies to control annual grasses and increase post-fire rehabilitation and restoration success. Differences in piñon and/or juniper landscape cover exist among MZs with 5,131,900 ha (12,681,202 ac) in MZ III, 528,377ha (1,305,649 ac) in MZ IV, and 558,880 ha (1,381,024 ac) in MZ V. Portions of MZs IV and V are still largely in early stages of juniper expansion indicating a need to address this threat before woodland succession progresses. Because of generally low resilience and resistance in MZ III, greater emphasis is needed on habitat conservation, specifically minimizing or eliminating stressors. Also, greater emphasis on reducing cover of piñon and juniper is needed to reduce woody fuels and increase sagebrush ecosystem resilience to fire by increasing the recovery potential of native understory species.

Interpretations at Regional and Local Land Management Scales: Northeast Nevada Example

The same land covers and data layers used to assess focal areas for sage-grouse habitat within MZs in the western portion of the species range can be used to evaluate focal areas for management in regional planning areas and land management planning units. The emphasis at the scale of the land planning area or management planning unit is on maintaining or increasing large contiguous areas of sagebrush habitat with covers in the 26-65% and especially >65% category. Resilience to disturbance and resistance to invasive annual grasses as indicated by soil temperature and moisture regimes is used to determine the most appropriate activities within the different cover categories. The sage-grouse habitat matrix in table 2 describes the capacity of areas with differing resilience and resistance to recover following disturbance and resist annual invasive grasses and provides the management implications for each of the different cover categories. Table 4 provides potential management strategies for the different sagebrush cover and resilience and resistance categories (cells) in the sage-grouse habitat matrix by agency program areas (fire operations, fuels management, post-fire rehabilitation, habitat restoration). Note that the guidelines in table 4 are related to the sage-grouse habitat matrix, and do not preclude other factors from consideration when determining management priorities for program areas.

Here, we provide an example of how to apply the concepts and tools discussed in this report by examining an important region identified in the MZ scale assessment. The northeastern corner of Nevada was selected to illustrate the diversity of sage-grouse habitat within planning areas and the need for proactive collaboration both within agencies and across jurisdictional boundaries in devising appropriate management strategies (figs. 17, 19, 21, 23, 25). This part of Nevada has large areas of invasive annual grasses and areas with piñon and juniper expansion, and it has experienced multiple large fires in the last decade. It includes a BLM Field Office, Forest Service (FS) land, State land, multiple private owners, and borders two States (fig. 29), which results in both complex ownership and natural complexity.

In the northeast corner of Nevada, an area 5,403,877 ha (13,353,271 ac) in size, numerous large fires have burned in and around PACs (fig. 25). Since 2000, a total of 1,144,317 ha (2,827,669 ac) have burned with the largest fires occurring in 2000, 2006, and 2007. This suggests that the primary management emphasis be on retaining existing areas of sagebrush in the 26-65% and especially >65% categories and promoting recovery of former sagebrush areas that have burned. Fire suppression in and around large, contiguous areas of sagebrush and also in and around successful habitat restoration or post-fire rehabilitation treatments is a first order priority. Fuels management also is a high priority and is focused on strategic placement of fuel breaks to reduce loss of large sagebrush stands by wildfire without jeopardizing existing habitat quality. Also, in the eastern portion of the area, piñon and juniper land cover comprises 471,645 ha (1,165,459 ac) (fig. 23). In this area, management priorities include (1) targeted tree removal in early to mid-phase (Phase I and II), post-settlement piñon and juniper expansion areas to maintain shrub/herbaceous cover and reduce fuel loads, and (2) targeted tree removal in later phase (Phase III) post-settlement piñon and juniper areas to reduce risk of high severity fire. In areas with moderate to high resilience and resistance, post-fire rehabilitation focuses on accelerating sagebrush establishment and recovery of perennial native herbaceous species. These areas often are capable of unassisted recovery and seeding is likely needed only in areas where perennial native herbaceous species have been depleted (Miller et al. 2013). Seeding introduced species can retard recovery of native perennial grasses and forbs that are important to sage-grouse and should be avoided in these areas (Knutson et al. 2014). Seeding or transplanting of sagebrush may be needed to accelerate establishment in focal areas.

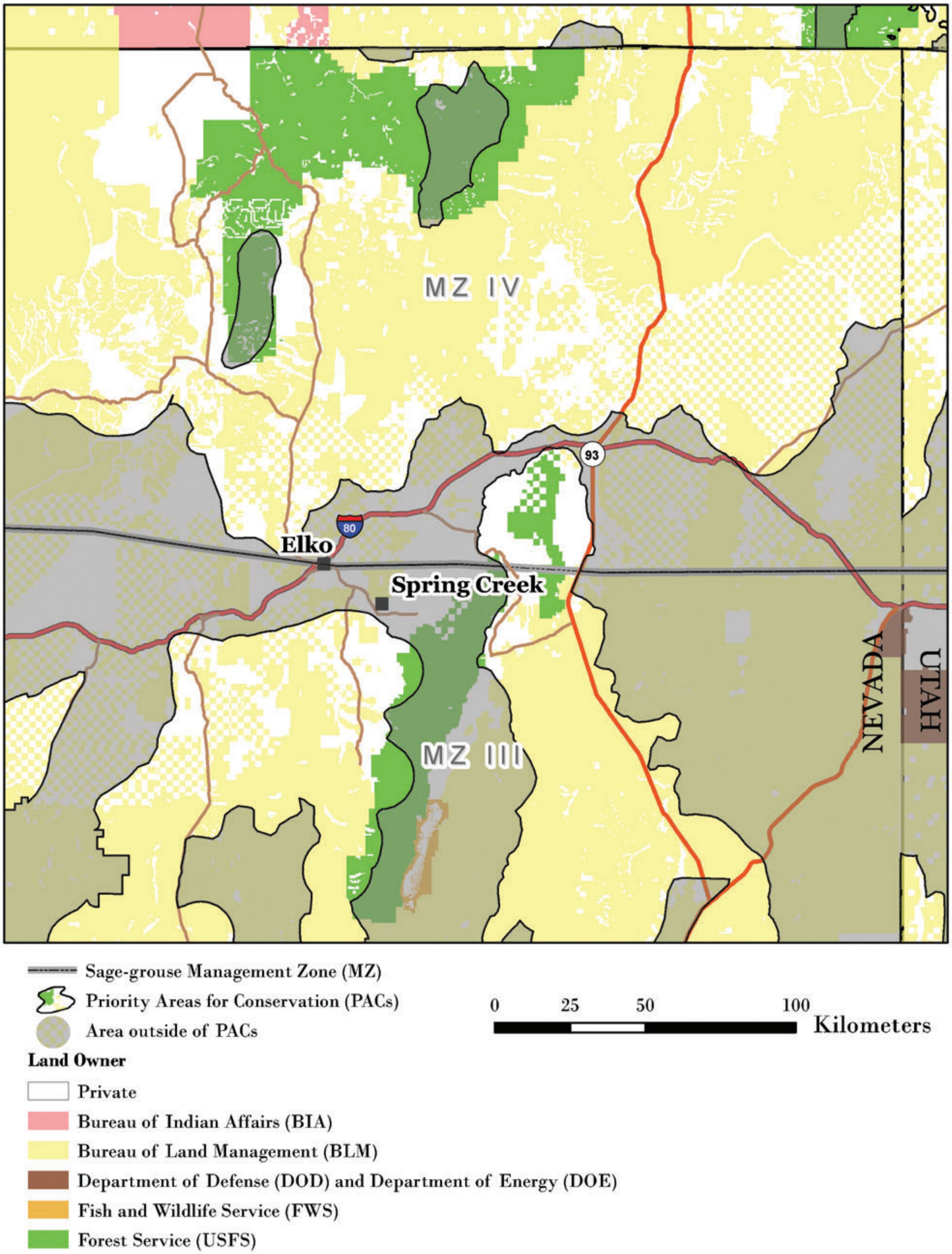

Figure 29. Land ownership for the northeast corner of Nevada. Lighter colored polygons delineate Priority Areas for Conservation (USFWS 2013).

In areas with lower resilience and resistance and high breeding bird densities, large, contiguous areas of sagebrush with intact understories are a high priority for conservation (figs. 17, 19, 27). In these areas, emphasis is on maintaining or increasing habitat conditions by minimizing stressors and disturbance. Post-fire rehabilitation and restoration activities focus on areas that increase connectivity among existing large areas of sagebrush. Because of low and variable precipitation, more than one intervention may be required to achieve restoration or rehabilitation goals. Appropriately managing livestock, wild horse and burro use (if applicable), and recreational use in focal areas is especially important to promote native perennial grass and forb growth and reproduction and to maintain or enhance resilience and resistance.

Determining the Most Appropriate Management Treatments at the Project Scale

Once focal areas and management priorities have been determined, potential treatment areas can be assessed to determine treatment feasibility and appropriate treatment methods. Different treatment options exist (figs. 30, 31) that differ in both suitability for a focal area and likely effectiveness. Field guides for sagebrush ecosystems and piñon and juniper expansion areas that incorporate resilience and resistance concepts are being developed to help guide managers through the process of determining both the suitability of an area for treatment and the most appropriate treatment. These guides are aligned with the different program areas and emphasize (1) fuel treatments (Miller et al. 2014a), (2) post-fire rehabilitation (Miller et al. 2014b), and (3) restoration (Pyke et al., in preparation). Additional information on implementing these types of management treatments is synthesized in Monsen et al. (2004) and Pyke (2011); additional information on treatment response is synthesized in Miller et al. (2013). In this section, we summarize the major steps in the process for determining the suitability of an area for treatment and the most appropriate treatment. We then provide an overview of two of the primary tools in the assessment process – ecological site descriptions (ESDs) and state and transition models (STMs). We conclude with a discussion of the importance of monitoring and adaptive management.

Steps in the process*:* Logical steps in the process of determining the suitability of an area for treatment and the most appropriate treatment(s) include (1) assessing the potential treatment area and identifying ecological sites, (2) determining the current successional state of the site, (3) selecting the appropriate action(s), and (4) monitoring and evaluation to determine post-treatment management. A general approach that uses questions to identify the information required in each step was developed (table 6). These questions can be modified to include the specific information needed for each program area and for treating different ecological sites. This format is used in the field guides described above.

Figure 30. Common vegetation treatments for sagebrush dominated ecosystems with relatively low resilience and resistance include seeding after wildfire in areas that lack sufficient native perennial grasses and forbs for recovery (top) (photo by Chad Boyd), and mowing sagebrush to reinvigorate native perennial grasses and forbs in the understory (bottom) (photo by Scott Schaff). Success of mowing treatments depends on having adequate perennial grasses and forbs on the site to resist invasive annual grasses and to promote recovery.

Figure 31. Vegetation treatments for sagebrush ecosystems exhibiting piñon and juniper expansion include cutting the trees with chainsaws and leaving them in place (top) (photo by Jeremy Roberts) and shredding them with a “bullhog” (middle) (photo by Bruce A. Roundy) on sites with relatively warm soils and moderately low resistance to cheatgrass. Prescribed fire (bottom) (photo by Jeanne C. Chambers) can be a viable treatment on sites with relatively cool and moist soils that have higher resilience to disturbance and resistance to invasive annual grasses. Treatment success depends on having adequate perennial grasses and forbs on the site to resist invasive annual grasses and promote recovery and will be highest on sites with relatively low densities of trees (Phase I to Phase II woodlands).

Table 6. General guidelines for conducting fuels management, fire rehabilitation, and restoration treatments (modified from Miller et al. 2007; Tausch et al. 2009; Pyke 2011; Chambers et al. 2013).

Steps in the process	Questions and considerations
I. Assess potential treatment area and identify ecological sites	1. Where are priority areas for fuels management, fire rehabilitation or restoration within the focal area? Consider sage-grouse habitat needs and resilience and resistance. 2. What are the topographic characteristics and soils of the area? Verify soils mapped to the location and determine soil temperature/moisture regimes. Collect information on soil texture, depth and basic chemistry for restoration projects. 3. How will topographic characteristics and soils affect vegetation recovery, plant establishment and erosion? Evaluate erosion risk based on topography and soil characteristics. 4. What are the potential native plant communities for the area? Match soil components to their correlated ESDs. This provides a list of potential species for the site(s).
II. Determine current state of the site	5. Is the area still within the reference state for the ecological site(s)?
III. Select appropriate action	6. How far do sites deviate from the reference state? How will treatment success be measured? 7. Do sufficient perennial shrubs and perennial grasses and forbs exist to facilitate recovery? 8. Are invasive species a minor component? 9. Do invasive species dominate the sites while native life forms are missing or severely under represented? If so, active restoration is required to restore habitat. 10. Are species from drier or warmer ecological sites present? Restoration with species from the drier or warmer sites should be considered. 11. Have soils or other aspects of the physical environment been altered? Sites may have crossed a threshold and represent a new ecological site type requiring new site-specific treatment/restoration approaches.
IV. Determine post-treatment management	12. How long should the sites be protected before land uses begin? In general, sites with lower resilience and resistance should be protected for longer periods. 13. How will monitoring be performed? Treatment effectiveness monitoring includes a complete set of measurements, analyses, and a report. 14. Are adjustments to the approach needed? Adaptive management is applied to future projects based on consistent findings from multiple locations.

Ecological site descriptions: ESDs and their associated STMs provide essential information for determining treatment feasibility and type of treatment. ESDs are part of a land classification system that describes the potential of a set of climate, topographic, and soil characteristics and natural disturbances to support a dynamic set of plant communities (Bestelmeyer et al. 2009; Stringham et al. 2003). NRCS soil survey data (http://soils.usda.gov/survey/), including soil temperature/moisture regimes and other soil characteristics, are integral to ESD development. ESDs have been developed by the NRCS and their partners to assist land management agencies and private land owners with making resource decisions, and are widely available for the Sage-grouse MZs except where soil surveys have not been completed (for a detailed description of ESDs and access to available ESDs see: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/). ESDs assist managers to step-down generalized vegetation dynamics, including the concepts of resilience and resistance, to local scales. For example, variability in soil characteristics and the local environment (e.g., average annual precipitation as indicated by soil moisture regime) can strongly influence both plant community resilience to fire as well as the resistance of a plant community to invasive annual grasses after fire (table 1). Within a particular ESD, there is a similar level of resilience to disturbance and resistance to invasive annuals and this information can be used to determine the most appropriate management actions.

State and transition models: STMs are a central component of ecological site descriptions that are widely used by managers to illustrate changes in plant communities and associated soil properties, causes of change, and effects of management interventions (Stringham et al. 2003; Briske et al. 2005; USDA NRCS 2007) including in sagebrush ecosystems (Forbis et al. 2006; Barbour et al. 2007; Boyd and Svejcar 2009; Holmes and Miller 2010; Chambers et al. *in press*). These models use ***state*** (a relatively stable set of plant communities that are resilient to disturbance) and ***transition*** (the drivers of change among alternative states) to describe the range in composition and function of plant communities within ESDs (Stringham and others 2003; see Appendix 1 for definitions). The reference state is based on the natural range of conditions associated with natural disturbance regimes and often includes several plant communities (***phases***) that differ in dominant plant species relative to type and time since disturbance (Caudle et al. 2013). Alternative states describe new sets of communities that result from factors such as inappropriate livestock use, invasion by annual grasses, or changes in fire regimes. Changes or transitions among states often are characterized by ***thresholds*** that may persist over time without active intervention, potentially causing irreversible changes in community composition, structure, and function. ***Restoration pathways*** are used to identify the environmental conditions and management actions required for return to a previous state. Detailed STMs that follow current interagency guidelines (Caudle et al. 2013), are aligned with the ecological types (table 1), and are generally applicable to MZs III (Southern Great Basin), IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin) are provided in Appendix 5.

A generalized STM to illustrate the use of STMs is shown in figure 32 for the warm and dry Wyoming big sagebrush ecological type. This ecological type occurs at relatively low elevations in the western part of the range and has low to moderate resilience to disturbance and management treatments and low resistance to invasion (table 1). This type is abundant in the western portion of the range, but as the STM suggests, it is highly susceptible to conversion to invasive annual grass and repeated fire and is difficult to restore. Intact sagebrush areas remaining in the reference state within this ecological type are a high priority for conservation. Invaded states or locations with intact sagebrush that lack adequate native perennial understory are a high priority for restoration where they bridge large, contiguous areas of sagebrush. However, practical methods to accomplish this are largely experimental and/or costly and further development, including adaptive science and management, is needed.

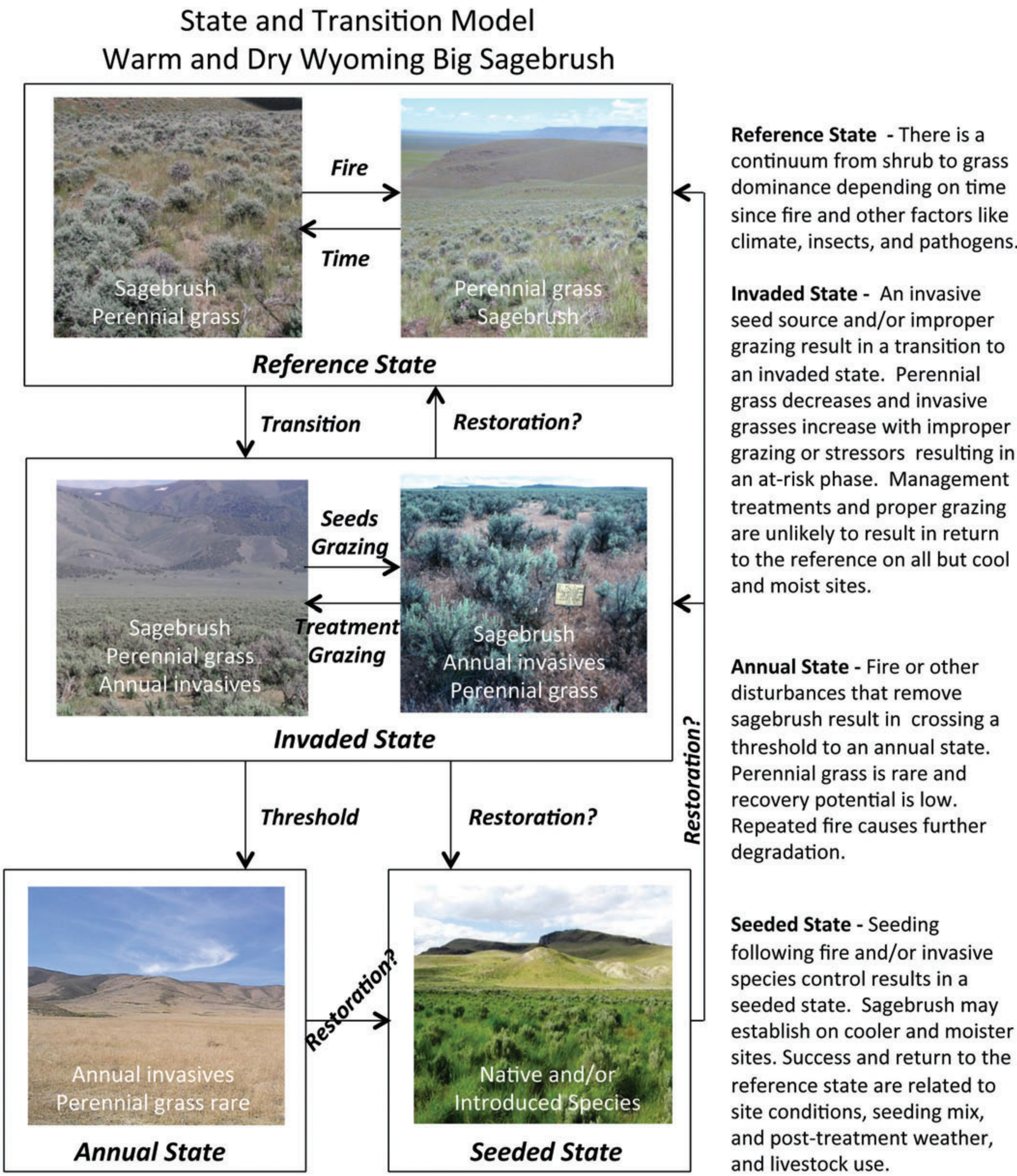

Figure 32. A state and transition model that illustrates vegetation dynamics and restoration pathways for the warm and dry, Wyoming big sagebrush ecological type. This ecological type occurs at relatively low elevations in the western part of the range and has low to moderate resilience to disturbance and management treatments and low resistance to invasion.

Monitoring and adaptive management: Monitoring programs designed to track ecosystem changes in response to both stressors and management actions can be used to increase understanding of ecosystem resilience and resistance, realign management approaches and treatments, and implement adaptive management (Reever-Morghan et al. 2006; Herrick et al. 2012). Information is increasing on likely changes in sagebrush ecosystems with additional stress and climate warming, but a large degree of uncertainty still exits. Currently, the NRCS National Resource Inventory is being used on private lands and is being implemented on public lands managed by BLM to monitor trends in vegetation attributes and land health at the landscape scale under the AIM (Assessment Inventory and Monitoring) strategy. Strategic placement of monitoring sites and repeated measurements of ecosystem status and trends (e.g., land cover type, ground cover, vegetation cover and height of native and invasive species, phase of tree expansion, soil and site stability, oddities) can be used to decrease uncertainty and increase effectiveness of management decisions. Ideally, monitoring sites span environmental/productivity gradients and sagebrush ecological types that characterize sage-grouse habitat. Of particular importance are (1) ecotones between ecological types where changes in response to climate are expected to be largest (Loehle 2000; Stohlgren et al. 2000), (2) ecological types with climatic conditions and soils that are exhibiting invasion and repeated fires, and (3) ecological types with climatic conditions and soils that are exhibiting tree expansion and increased fire risk. Monitoring the response of sagebrush ecosystems to management treatments, including both pre- and post-treatment data, is a first order priority because it provides information on treatment effectiveness that can be used to adjust methodologies.

Monitoring activities are most beneficial when consistent approaches are used among and within agencies to collect, analyze, and report monitoring data. Currently, effectiveness monitoring databases that are used by multiple agencies do not exist. However, several databases have been developed for tracking fire-related and invasive-species management activities. The National Fire Plan Operations and Reporting System (NFPORS) is an interdepartmental and interagency database that accounts for hazardous fuel reduction, burned area rehabilitation and community assistance activities. To our knowledge, NFPORS is not capable of storing and retrieving the type of effectiveness monitoring information that is needed for adaptive management. The FEAT FIREMON Integrated (FFI; https://www.frames.gov/partner-sites/ffi/ffi-home/) is a monitoring software tool designed to assist managers with collection, storage and analysis of ecological information. It was constructed through a complementary integration of the Fire Ecology Assessment Tool (FEAT) and FIREMON. This tool allows the user to select among multiple techniques for effectiveness monitoring. If effectiveness monitoring techniques were agreed on by the agencies, FFI does provide databases with standard structures that could be used in inter-agency effectiveness monitoring. Also, the National Invasive Species Information Management System (NISIMS) is designed to reduce redundant data entry regarding invasive species inventory, management and effectiveness monitoring with the goal of providing information that can be used to determine effective treatments for invasive species. However, NISIMS is currently available only within the BLM.

Common databases can be used by agency partners to record and share monitoring data. The Land Treatment Digital Library (LTDL [USGS 2010]) provides a method of archiving and collecting common information for land treatments and might be used as a framework for data storage and retrieval. Provided databases are relational (maintain a common field for connecting them), creating single corporate databases is not necessary. However, barriers that hinder database access within and among agencies and governmental departments may need to be lowered while still maintaining adequate data security. The LTDL has demonstrated how this can work by accessing a variety of databases to populate useful information relating to land treatments.

For effectiveness of treatments to be easily useable for adaptive management, the agencies involved will need to agree on monitoring methods and a common data storage and retrieval system. Once data can be retrieved, similar treatment projects can be evaluated to determine how well they achieve objectives for sage-grouse habitat, such as the criteria outlined in documents like the Habitat Assessment Framework (Stiver et al. 2006). Results of monitoring activities on treatment effectiveness are most useful when shared across jurisdictional boundaries, and several mechanisms are currently in place to improve information sharing (e.g., the Great Basin Fire Science Delivery Project; www.gbfiresci.org).

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Appendix 1. Definitions of Terms Used in This Document

At-Risk Community Phase — A community phase that can be designated within the reference state and also in alternative states. This community phase is the most vulnerable to transition to an alternative state (Caudle et al. 2013).

Community Phase — A unique assemblage of plants and associated soil properties that can occur within a state (Caudle et al. 2013).

Ecological Site (ES) — An Ecological Site (ES) is a conceptual division of the landscape that is defined as a distinctive kind of land based on recurring soil, landform, geological, and climate characteristics that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its ability to respond similarly to management actions and natural disturbances (Caudle et al. 2013).

Ecological Site Descriptions (ESD) — The documentation of the characteristics of an ecological site. The documentation includes the data used to define the distinctive properties and characteristics of the ecological site; the biotic and abiotic characteristics that differentiate the site (i.e., climate, topography, soil characteristics, plant communities); and the ecological dynamics of the site that describes how changes in disturbance processes and management can affect the site. An ESD also provides interpretations about the land uses and ecosystem services that a particular ecological site can support and management alternatives for achieving land management (Caudle et al. 2013).

Ecological Type — A category of land with a distinctive (i.e., mappable) combination of landscape elements. The elements making up an ecological type are climate, geology, geomorphology, soils, and potential natural vegetation. Ecological types differ from each other in their ability to produce vegetation and respond to management and natural disturbances (Caudle et al. 2013).

Historical Range of Variability — Range of variability in disturbances, stressors, and ecosystem attributes that allows for maintenance of ecosystem resilience and resistance and that can be used to provide management targets (modified from Jackson 2006).

Resilience — Ability of a species and/or its habitat to recover from stresses and disturbances. Resilient ecosystems regain their fundamental structure, processes, and functioning when altered by stresses like increased CO_2 , nitrogen deposition, and drought and to disturbances like land development and fire (Allen et al. 2005; Holling 1973).

Resistance — Capacity of an ecosystem to retain its fundamental structure, processes and functioning (or remain largely unchanged) despite stresses, disturbances, or invasive species (Folke et al. 2004).

Resistance to Invasion — Abiotic and biotic attributes and ecological processes of an ecosystem that limit the population growth of an invading species (D'Antonio and Thomsen 2004).

Restoration Pathways — Restoration pathways describe the environmental conditions and practices that are required for a state to recover that has undergone a transition (Caudle et al. 2013).

State — A state is a suite of community phases and their inherent soil properties that interact with the abiotic and biotic environment to produce persistent functional and structural attributes associated with a characteristic range of variability (adapted from Briske et al. 2008).

State-and-Transition Model — A method to organize and communicate complex information about the relationships between vegetation, soil, animals, hydrology, disturbances (fire, lack of fire, grazing and browsing, drought, unusually wet periods, insects and disease), and management actions on an ecological site (Caudle et al. 2013).

Thresholds — Conditions sufficient to modify ecosystem structure and function beyond the limits of ecological resilience, resulting in the formation of alternative states (Briske et al. 2008).

Transition — Transitions describe the biotic or abiotic variables or events, acting independently or in combination, that contributes directly to loss of state resilience and result in shifts between states. Transitions are often triggered by disturbances, including natural events (climatic events or fire) and/or management actions (grazing, burning, fire suppression). They can occur quickly as in the case of catastrophic events like fire or flood, or over a long period of time as in the case of a gradual shift in climate patterns or repeated stresses like frequent fires (Caudle et al. 2013).

Appendix 2. An Explanation of the Use of Landscape Measures to Describe Sagebrush Habitat

Understanding landscape concepts of plant cover relative to typical management unit concepts of plant cover is important for prioritizing lands for management of sage-grouse. Ground cover measurements of sagebrush made at a management unit (for example, line-intercept measurements) should not be confused for landscape cover and may not relate well to landscape cover since the areas of examination differ vastly (square meters for management units and square kilometers for landscapes).

A landscape is defined rather arbitrarily as a large area in total spatial extent, somewhere in size between sites (acres or square miles) and regions (100,000s of square miles). The basic unit of a landscape is a patch, which is defined as a bounded area characterized by a similar set of conditions. A habitat patch, for example, may be the polygonal area on a map representing a single land cover type. Landscapes are composed of a mosaic of patches. The arrangement of these patches (the landscape configuration or pattern) has a large influence on the way a landscape functions and for landscape species, such as sage-grouse, sagebrush habitat patches are extremely important for predicting if this bird will be present within the area (Connelly et al. 2011).

Remotely sensed data of land cover is typically used to represent landscapes. These data may combine several sources of data and may include ancillary data, such as elevation, to improve the interpretation of data. These data are organized into pixels that contain a size or grain of land area. For example, LandSat Thematic Mapper spectral data used in determining vegetation cover generally have pixels that represent ground areas of 900 m^2 (30- x 30-m). Each pixel's spectral signature can be interpreted to determine what type of vegetation dominates that pixel. Groups of adjacent pixels with the same dominant vegetation are clustered together into polygons that form patches.

Landscape cover of sagebrush is determined initially by using this vegetation cover map, but a 'rolling window' of a predetermined size (e.g., 5 km^2 or 5,556 pixels that are 30- by 30-m in size) is moved across the region one pixel at a time. The central pixel of the 'window' is reassigned a value for the proportion of pixels where sagebrush is the dominant vegetation. The process is repeated until pixels within the region are completely reassigned to represent the landscape cover of sagebrush within for the region drawn from a 5 km^2 window.

Appendix 3. An Explanation of Soil Temperature and Moisture Regimes Used to Describe Sagebrush Ecosystems

Soil climate regimes (temperature and moisture) are used in Soil Taxonomy to classify soils; they are important to consider in land management decisions, in part, because of the significant influence on the amounts and kinds of vegetation that soils support. Soil temperature and moisture regimes are assigned to soil map unit components as part of the National Cooperative Soil Survey program. Soil survey spatial and tabular data for the Sage-grouse Management Zones (Stiver et al. 2006) were obtained for each State within the zones at the Geospatial Data Gateway (http://datagateway.nrcs.usda.gov/). Gridded Soil Survey Geographic (gSSURGO) file geodatabases were used to display a 10-meter raster dataset. Multiple soil components made up a soil map unit, and soil moisture and temperature regimes were linked to individual soil map components. Soil components with the same soil moisture and temperature class regime were aggregated, and the dominant soil moisture and temperature regime within each soil map unit was used to characterize the temperature and moisture regime. Only temperature and moisture regimes applicable to sagebrush ecosystems were displayed.

Abbreviated definitions of each soil temperature and moisture regime class are listed below. Complete descriptions can be found in *Keys to Soil Taxonsomy, 11th edition*, available at ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Taxonomy/keys/2010_Keys_to_Soil_Taxonomy.pdf.

Soil temperature regimes	
Cryic (Cold)	Soils that have a mean annual soil temperature of <8 °C, and do not have permafrost, at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Frigid (Cool)	Soils that have a mean annual soil temperature of <8 °C and the difference between mean summer and mean winter soil temperatures is >6 °C at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Mesic (Warm)	Soils that have a mean annual soil temperature of 8-15 °C and the difference between mean summer and mean winter soil temperatures is >6 °C at a depth of 50 cm below the surface or at a restrictive feature, whichever is shallower.
Soil moisture regimes	
Ustic (summer precipitation)	Generally there is some plant-available moisture during the growing season, although significant periods of drought may occur. Summer precipitation allows presence of warm season plant species.
Xeric (Moist; generally mapped at >12 inches mean annual precipitation)	Characteristic of arid regions. The soil is dry for at least half the growing season and moist for less than 90 consecutive days.
Aridic (Dry; generally mapped at <12 inches mean annual precipitation)	Characteristic of arid regions. The soil is dry for at least half the growing season and moist for less than 90 consecutive days.

Note: Soil moisture regimes are further divided into moisture subclasses, which are often used to indicate soils that are transitional to another moisture regime. For example, a soil with an Aridic moisture regime and a Xeric moisture subclass may be described as "Aridic bordering on Xeric." Understanding these gradients becomes increasingly important when making interpretations and decisions at the site scale where aspect, slope, and soils affect the actual moisture regime on that site. More information on taxonomic moisture subclasses is available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053576.

Appendix 4. Data Sources for the Maps in This Report

Dataset	Citation	Link
Geomac fire perimeters	Walters, S.P.; Schneider, N.J.; Guthrie, J.D. 2011. Geospatial Multi-Agency Coordination (GeoMAC) wildland fire perimeters, 2008. Data Series 612. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey.6 p.	http://pubs.er.usgs.gov/publication/ds612
WFDSS fire perimeters	Butler, B. B.; Bailey, A. 2013. Disturbance history (Historical wildland fires). Updated 8/9/2013. Wildland Fire Decision Support System. Online: https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml [Accessed 5 March 2014].	https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml or https://wfdss.usgs.gov/wfdss/WFDSSData_Downloads.shtml
Piñon and juniper land cover	U.S. Geological Survery (USGS) National Gap Analysis Program. 2004. Provisional digital land cover map for the southwestern United States. Version 1.0. Logan, UT: Utah State University, College of Natural Resources, RS/GIS Laboratory.	http://earth.gis.usu.edu/swgap/landcover.html
Piñon and juniper land cover	U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 13 March 2014].	http://www.landfire.gov/NationalProductDescriptions21.php
Nevada invasive annual grass index	Peterson, E. B. 2006. A map of invasive annual grasses in Nevada derived from multitemporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.	http://heritage.nv.gov/node/167
Owhyee upland annual grass index	Peterson, E. B. 2007. A map of annual grasses in the Owyhee Uplands, Spring 2006, derived from multitemporal Landsat 5 TM imagery. Carson City, NV: State of Nevada, Department of Conservation and Natural Resources, Nevada Natural Heritage Program.	http://heritage.nv.gov/sites/default/files/library/anngrowy_text_print.pdf
Soil data (SSURGO)	Soil Survey Staff. 2014a. Soil Survey Geographic (SSURGO) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014a].	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627
Soil data (STATSGO)	Soil Survey Staff. 2014b. U.S. General Soil Map (STATSGO2) Database. United States Department of Agriculture, Natural Resources Conservation Service. Online: http://sdmdataaccess.nrcs.usda.gov/. [Accessed 3 March 2014b].	

Soil temperature and moisture regime data	Campbell, S. B. 2014. Soil temperature and moisture regime data for the range of greater sage-grouse. Data product. Portland, OR: USDA Natural Resources Conservation Service. Online: https://www.sciencebase.gov/catalog/folder/537f8be5e4b021317a872f1b?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal [Accessed 17 June 2014].	https://www.sciencebase.gov/catalog/folder/537f8be5e4b021317a872f1b?community=LC+MAP+-+Landscape+Conservation+Management+and+Analysis+Portal
Sage-grouse management zones	Stiver, S. J.; Apa, A. D.; Bohne, J. R.; Bunnell, S. D.; Deibert, P. A.; Gardner, S. C.; Hilliard, M. A.; McCarthy, C. W.; Schroeder, M. A. 2006. Greater Sage-grouse Comprehensive Conservation Strategy. Unpublished report on file at: Western Association of Fish and Wildlife Agencies, Cheyenne, WY.	
Breeding bird densities	Doherty, K. E.; Tack, J. D.; Evans, J. S.; Naugle, D. E. 2010. Mapping breeding densities of greater sage-grouse: A tool for range-wide conservation planning. BLM completion report: Agreement # L10PG00911.	http://scholar.google.com/scholar?q=doherty+2010+breeding+bird&hl=en&as_sdt=0&as_vis=1&oi=scholart&sa=X&ei=JqQbU7HUAqfD2QW8xYFY&ved=0CCUQgQMwAA
Sagebrush land cover	U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 13 March 2014].	http://www.landfire.gov/NationalProductDescriptions21.php

Appendix 5. State-and-transition models (STMs) for five generalized ecological types for big sagebrush (from Chambers et al. *in press*; Miller et al. 2014 a, b)

These STMs represent groupings of ecological sites that are characterized by Wyoming or mountain big sagebrush, span a range of soil moisture/temperature regimes (warm/dry to cold/moist), and characterize a large portion of Management Zones III (Southern Great Basin), IV (Snake River Plains), V (Northern Great Basin), and VI (Columbia Basin). Large boxes illustrate states that are comprised of community phases (smaller boxes). Transitions among states are shown with arrows starting with T; restoration pathways are shown with arrows starting with R. The "at risk" community phase is most vulnerable to transition to an alternative state. Precipitation Zone is designated as PZ.

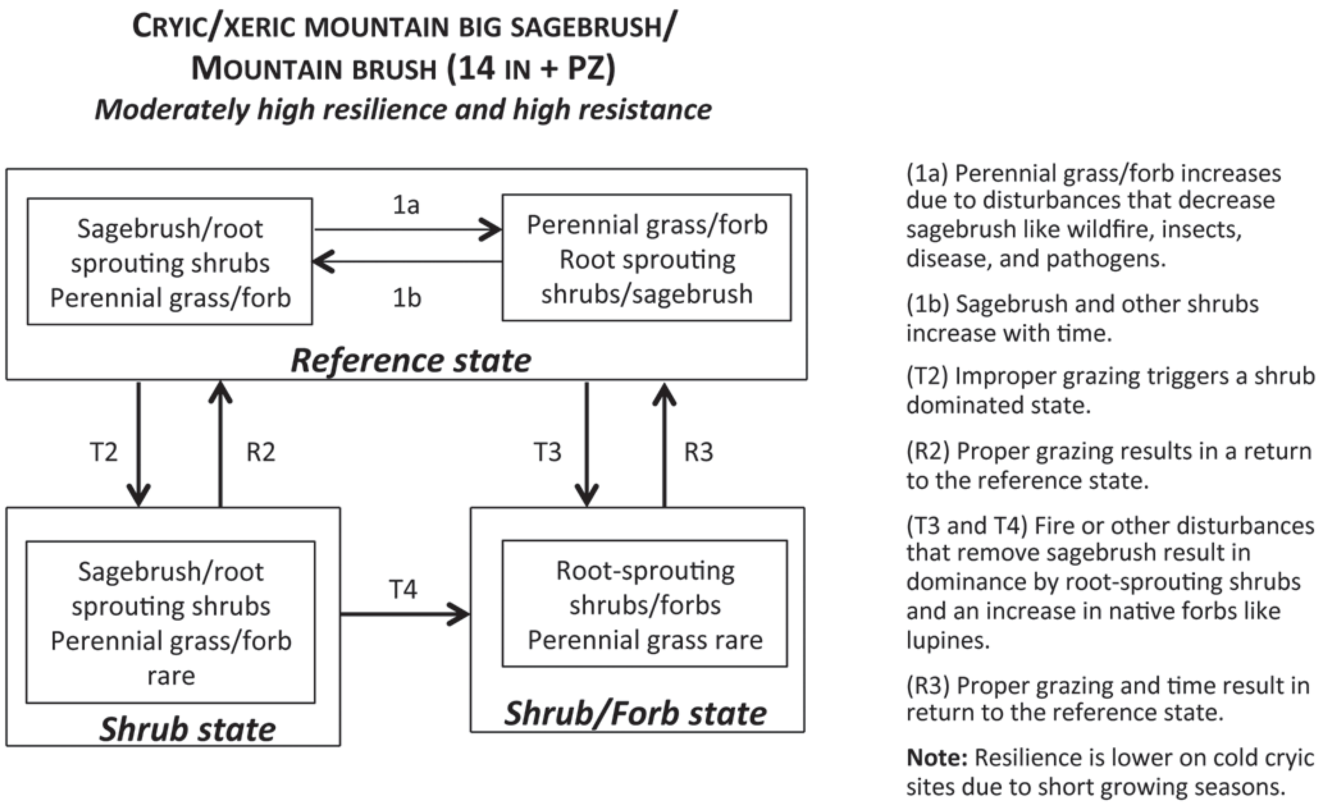
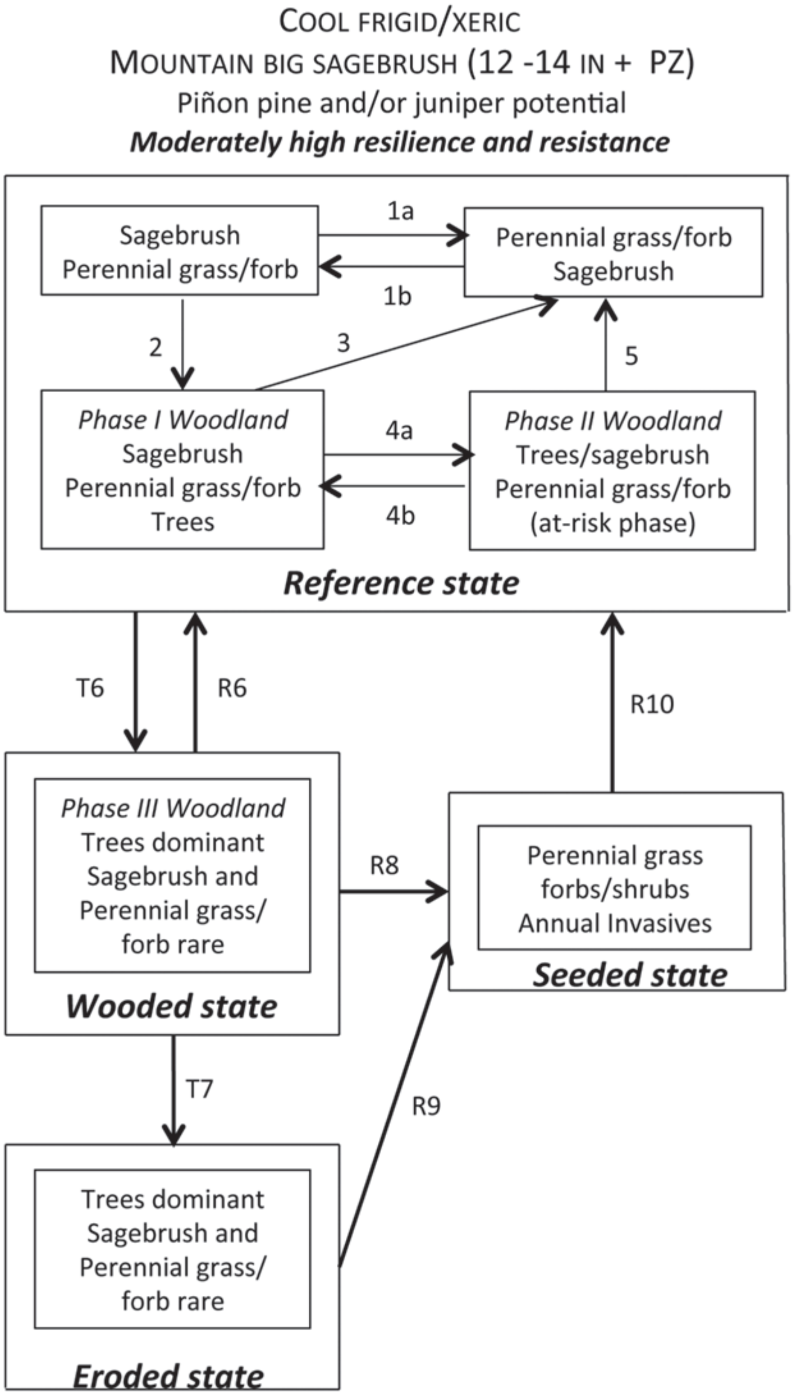


Figure A.5A. STM for a cryic/xeric mountain big sagebrush/mountain brush ecological type characterized by moderately high resilience and high resistance.



(1a) Disturbances such as wildfire, insects, disease, and pathogens result in less sagebrush and more perennial grass/forb.

(1b) Sagebrush increases with time .

(2) Time combined with seed sources for piñon and/or juniper trigger a Phase I Woodland.

(3 and 5) Fire and or fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore perennial grass/forb and sagebrush dominance.

(4a) Increasing tree abundance results in a Phase II woodland with depleted perennial grass/forb and shrubs and an at-risk phase.

(4b) Fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore perennial grass/forb and sagebrush dominance.

(T6) Infilling of trees and/or improper grazing can result in a biotic threshold crossing to a wooded state with increased risk of high severity crown fires .

(R6) Fire, herbicides and/or mechanical treatments that remove trees may restore perennial grass/forb and sagebrush dominance.

(T7) An irreversible abiotic threshold crossing to an eroded state can occur depending on soils, slope, and understory species.

(R8 and R9) Seeding after fire may be required on sites with depleted perennial grass/forb, but seeding with aggressive introduced species can decrease native perennial grass/forb. Annual invasives are typically rare. Seeded eroded states may have lower productivity.

(R10) Depending on seed mix and grazing, return to the reference state may be possible if an irreversible threshold has not been crossed.

Figure A.5B. STM for a cool frigid/xeric mountain big sagebrush ecological type that has piñon pine and/or juniper potential and is characterized by moderately high resilience and resistance.

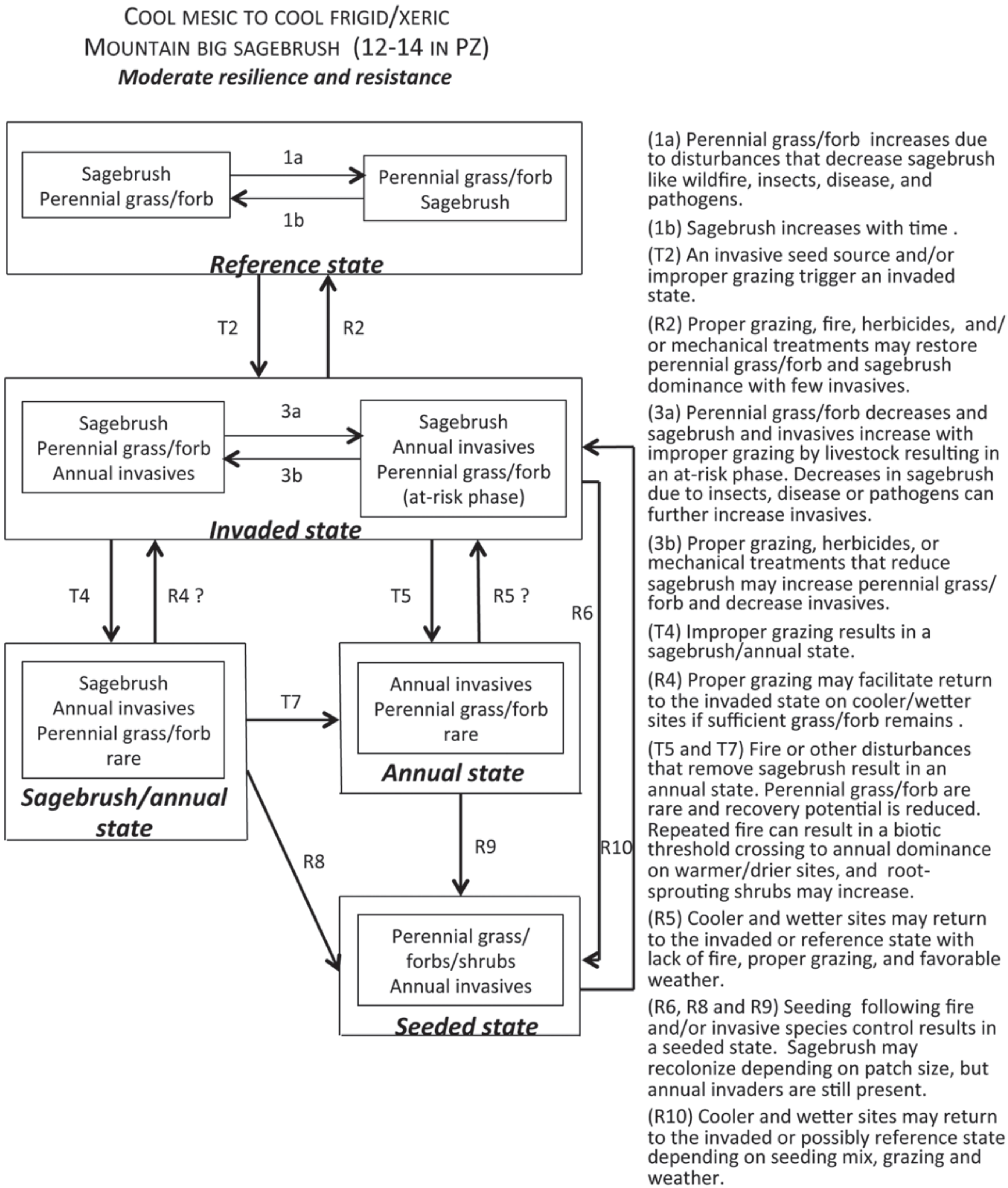
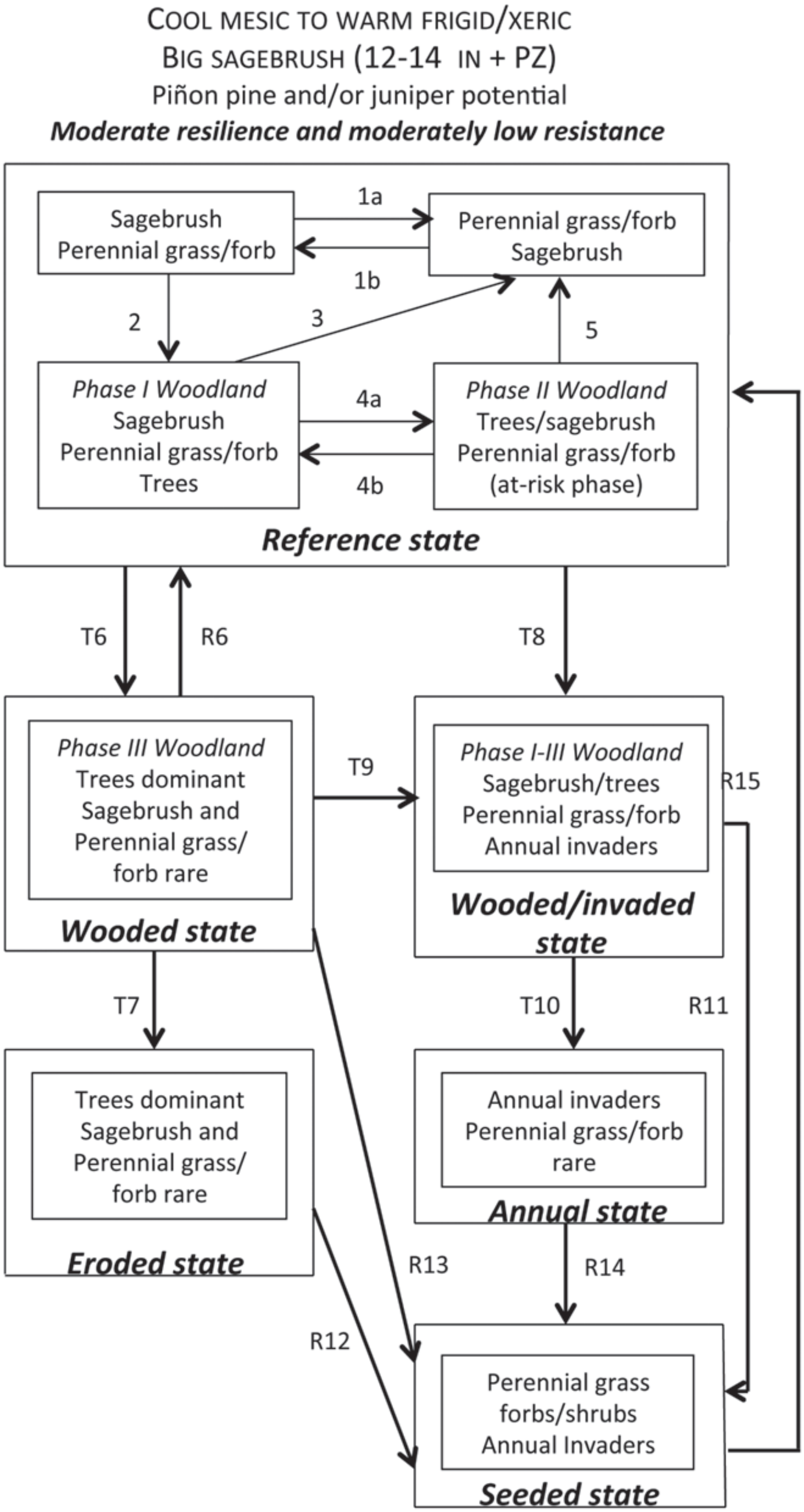


Figure A.5C. STM for a cool mesic to cool frigid/xeric mountain big sagebrush ecological type that is characterized by moderate resilience and resistance.



(1a) Disturbances such as wildfire, insects, disease, and pathogens result in less sagebrush and more perennial grass/forb.

(1b) Sagebrush increases with time .

(2) Time combined with seed sources for piñon and/or juniper trigger a Phase I Woodland.

(3 and 5) Fire and or fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore perennial grass/forb and sagebrush dominance on cooler/wetter sites. On warmer/drier sites with low perennial grass/forb abundance resistance to invasion is moderately low.

(4a) Increasing tree abundance results in a Phase II woodland with depleted perennial grass/forb and shrubs and an at-risk phase.

(4b) Fire surrogates (herbicides and/or mechanical treatments) that remove trees may restore sagebrush and perennial grass/forb dominance .

(T6) Infilling of trees and improper grazing can result in a biotic threshold crossing to a wooded state with increased risk of high severity crown fires.

(R6) Fire, herbicides and/or mechanical treatments that remove trees may restore perennial grass/forb and sagebrush dominance on cooler/wetter sites.

(T7) An irreversible abiotic threshold crossing to an eroded state can occur depending on soils, slope, and understory species.

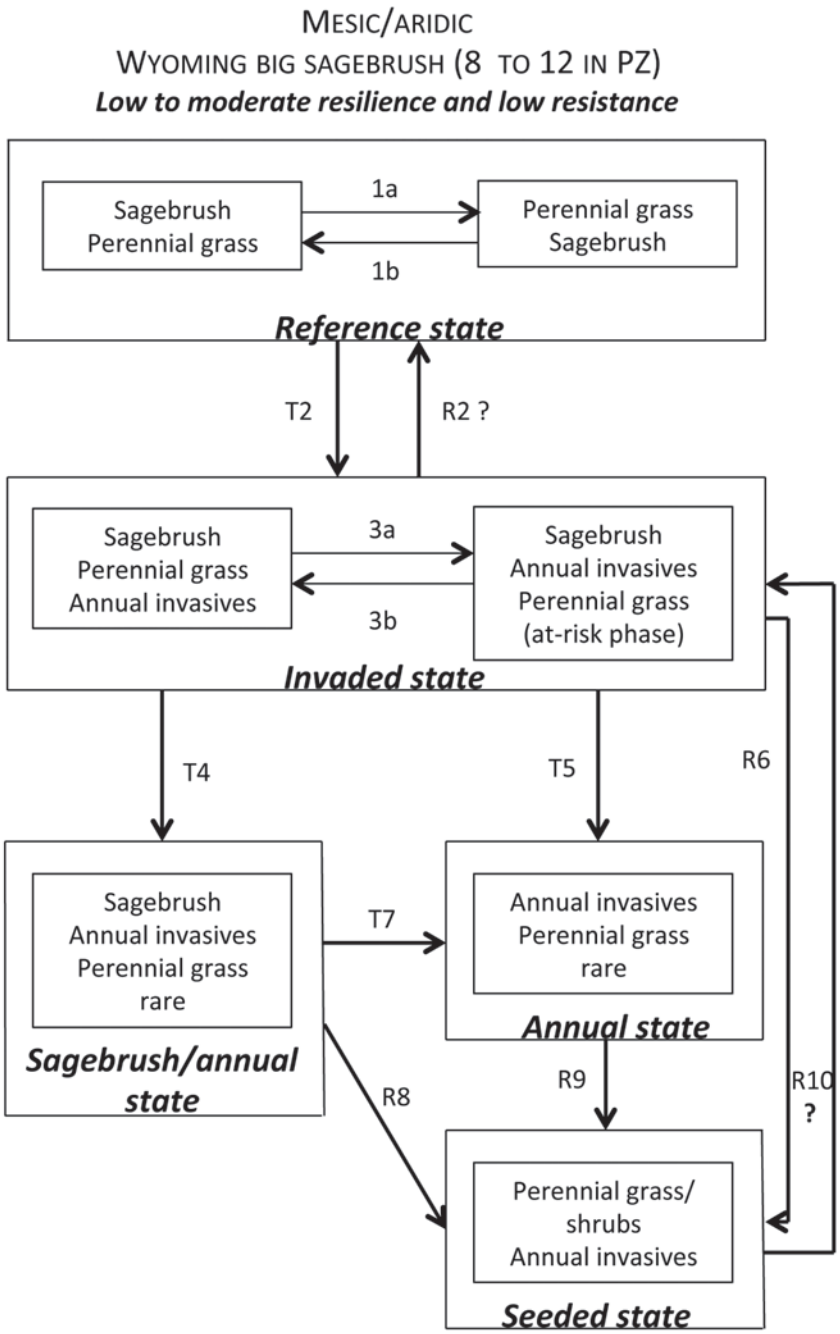
(T8 and T9) An invasive seed source and/or improper grazing can trigger a wooded/invaded state.

(T10) Fire or other disturbances that remove trees and sagebrush can result in a biotic threshold crossing to annual dominance on warmer/drier sites with low resilience.

(R11, R12, R13, and R14) Seeding after fire and/or invasive species control increases perennial grass/forb. Sagebrush may recolonize depending on seed sources, but annual invaders are still present. Seeded eroded states may have lower productivity.

(R15) Depending on seed mix , grazing, and level of erosion, return to the reference state may occur on cooler and wetter sites if an irreversible threshold has not been crossed.

Figure A.5D. STM for a cool mesic to warm frigid/xeric mountain big sagebrush ecological type type that has piñon pine and/or juniper potential and is characterized by moderate resilience and moderately low resistance.



(1a) Perennial grass increases due to disturbances that decrease sagebrush like wildfire, insects, disease, and pathogens.
(1b) Sagebrush increases with time .
(T2) An invasive seed source and/or improper grazing trigger an invaded state.
(R2) Proper grazing, fire, herbicides and/ or mechanical treatments are unlikely to result in return to the reference state on all but the coolest and wettest sites.
(3a) Perennial grass decreases and both sagebrush and invasives increase with improper grazing resulting in an at-risk phase. Decreases in sagebrush due to insects, disease or pathogens can further increase invasives.
(3b) Proper grazing and herbicides or mechanical treatments that reduce sagebrush may restore perennial grass and decrease invaders on wetter sites (10-12”). Outcomes are less certain on drier sites (8-10”) and/or low abundance of perennial grass.
(T4) Improper grazing triggers a largely irreversible threshold to a sagebrush/ annual state.
(T 5 and T7) Fire or other disturbances that remove sagebrush result in an annual state. Perennial grass is rare and recovery potential is low due to low precipitation, mesic soil temperatures, and competition from annual invasives. Repeated fire can cause further degradation.
(R6, R8 and R9) Seeding following fire and/or invasive species control results in a seeded state. Sagebrush may recolonize depending on patch size, but annual invasives are still present.
(R10) Seeding effectiveness and return to the invaded state are related to site conditions, seeding mix, and post-treatment weather.

Figure A.5E. STM for a mesic/aridic Wyoming big sagebrush ecological type with low to moderate resilience and low resistance.

Greater Sage-Grouse Wildfire, Invasive Annual Grasses & Conifer Expansion Assessment

June 2014

Suggested Citation:

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Introduction and Background

The purpose of this assessment is to identify priority habitat areas and management strategies to reduce the threats to Greater Sage-Grouse resulting from impacts of invasive annual grasses, wildfires, and conifer expansion. The Conservation Objectives Team (COT) report (USFWS 2013) and other scientific publications identify wildfire and conversion of sagebrush habitat to invasive annual grass dominated vegetative communities as two of the primary threats to the sustainability of Greater Sage-Grouse (*Centrocercus urophasianus*, hereafter sage-grouse) in the western portion of the species range. For the purposes of this assessment protocol, invasive species are limited to, and hereafter referred to, as **invasive annual grasses** (e.g., primarily cheatgrass [*Bromus tectorum*]). Conifer expansion (also called encroachment) is also addressed in this assessment.

The United States Fish and Wildlife Service (USFWS) will consider the amelioration of impacts, location and extent of treatments, degree of fire risk reduction, locations for suppression priorities, and other proactive measures to conserve sage-grouse in their 2015 listing decision. This determination will be made based in part upon information contained in the United States (US) Department of the Interior, Bureau of Land Management (BLM) resource management plan (RMP) amendments and Forest Service land resource management plan (LRMP) amendments, including this assessment.

This assessment is based in part on National Resources Conservation Service (NRCS) soil surveys that include geospatial information on soil temperature and moisture regimes associated with resistance and resiliency properties (see following section on *Soil Temperature and Moisture Regimes)*. While this assessment is applicable across the range of sage-grouse, the analysis is limited to Western Association of Fish and Wildlife Management Agencies' (WAFWA) Management Zones III, IV, and V (roughly the Great Basin region) because of the significant issues associated with invasive annual grasses and the high level of wildfires in this region. The utility of this assessment process is dependent on incorporating improved information and geospatial data as it becomes available. Although the resistance and resilience concepts have broad applications (e.g., infrastructure development), this assessment is limited to developing strategies to reduce threats to sage-grouse habitat (e.g., invasive annual grasses and wildfires).

Draft Greater Sage-Grouse Environmental Impact Statements (EISs) contain a suggested framework in the appendices ("Draft Greater Sage-Grouse Wildland Fire and Invasive Species Assessment") that provided a consistent approach to conduct these assessments. The current protocol was developed by the Fire and Invasive Species Team (FIAT), a team of wildland fire specialists and other resource specialists and managers, to specifically incorporate resistance to invasive annual grasses and resilience after disturbance principles into the assessment protocol. This protocol is also referred to as the Fire and Invasive Tool. In October 2013, the BLM, Forest Service, and USFWS agreed to incorporate this approach into the final EISs.

The cornerstone of the FIAT protocol is recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. 2014) and the USFWS-sponsored project with the Western Association of Fish and Wildlife Agencies (WAFWA) to assemble an interdisciplinary team to provide additional information on wildland fire and invasive plants and to develop strategies for addressing these issues. This interagency collaboration between rangeland scientists, fire specialists, and sage-grouse biologists resulted in the development of a strategic, multi-scale approach for employing ecosystem resilience and resistance concepts to manage threats to sage-grouse habitats from wildfire and invasive annual grasses (Chambers et al. 2014). This paper has been published as a Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-326 and is posted online at http://www.fs.fed.us/rm/pubs/rmrs_gtr326.pdf. It serves as the reference and basis for the protocol described in this assessment.

The assessment process sets the stage for:

- Identifying important sage-grouse occupied habitats and baseline data layers important in defining and prioritizing sage-grouse habitats
- Assessing the resistance to invasive annual grasses and resilience after disturbance and prioritizing focal habitats for conservation and restoration
- Identifying geospatially explicit management strategies to conserve sage-grouse habitats

Management strategies are types of actions or treatments that managers typically implement to resolve resource issues. They can be divided into proactive approaches (e.g., fuels management and habitat recovery/restoration) and reactive approaches (e.g., fire operations and post-fire rehabilitation). Proactive management strategies can favorably modify wildfire behavior and restore or improve desirable habitat with greater resistance to invasive annual grasses and/or resilience after disturbances such as wildfires. Reactive management strategies are employed to reduce the loss of sage-grouse habitat from wildfires or stabilize soils and reduce impacts of invasive annual grasses in sage-grouse habitat after wildfires. Proactive management strategies will result in long-term sage-grouse habitat improvement and stability, while reactive management strategies are essential to reducing current impacts of wildfires on sage-grouse habitat, thus maintaining long-term habitat stability. Management strategies include:

Proactive Strategies-

1. **Fuels Management** includes projects that are designed to change vegetation composition and/or structure to modify fire behavior characteristics for the purpose of aiding in fire suppression and reducing fire extent.

2. **Habitat Restoration/Recovery**
    a. Recovery, referred to as passive restoration (Pyke 2011), is focused on changes in land use (e.g., improved livestock grazing practices) to achieve a desired outcome where the plant community has not crossed a biotic or physical threshold.
    b. Restoration is equivalent to active restoration (Pyke 2011) and is needed when desired species or structural groups are poorly represented in the community and reseeding, often preceded by removal of undesirable species, is required. Note: The Fuels Management program supports recovery/restoration projects through its objective to restore and maintain resilient landscapes.

Reactive Strategies-

3. **Fire Operations** includes preparedness, prevention, and suppression activities. When discussing specific components of fire operations, the terms fire preparedness, fire prevention and fire suppression are used.

4. **Post-Fire Rehabilitation** includes the BLM's Emergency Stabilization and Rehabilitation (ES&R) Program and the Forest Service's Burned Area Emergency Response (BAER) Program. Policy limits application of funds from 1 to 3 years, thus treatments to restore or enhance habitat after this period of time are considered habitat recovery/restoration.

The assessment process included two steps with sub-elements. First, important Priority Areas for Conservation (PACs) and focal habitats are identified (**Step 1a**). Second, potential management **strategies** (described above) are identified to conserve or restore focal habitats threatened by wildfires, invasive annual grasses, and conifer expansion (primarily pinyon pine and/or juniper species; **Step 1b**). Focal habitats are the portions of a PAC with important habitat characteristics, bird populations, and threats (e.g., wildfires, invasive annual grasses, and conifer expansion) where this assessment will be applied. Areas adjacent to or near the focal habitats can be considered for management treatments such as fire control and fuels management if these locations can reduce wildfire impacts to focal habitats. Soil temperature and moisture regimes are used to characterize capacity for resistance to invasive annual grasses and resilience after disturbance (primarily wildfires) within focal habitats to assist in identifying appropriate management strategies, especially in areas with good habitat characteristics that have low recovery potential following disturbance. Soil moisture and temperature regime relationships have not been quantified to the same degree as for conifer expansion; however, Chambers et al. 2014) discuss preliminary correlations between these two variables.

The results of Steps 1a and 1b, along with associated geospatial data files, are available to local management units to complete Step 2 of the assessment process. Step 2 is conducted by local management units to address wildfire, invasive annual grasses, and conifer expansion in or near focal habitat areas. First, local information and geospatial data are collected and evaluated to apply and improve on Step 1 focal habitat area geospatial data (**Step 2a**). Second, focal habitat activity and implementation plans are developed and include prioritized management **tactics and treatments** to implement effective, fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation strategies (**Step 2b**). This assessment will work best if Step 2b is done across management units (internal and externally across BLM and Forest Service administrative units and with other entities). **Figure 1**, Assessment Flow Chart, contains an illustration of the steps in the assessment process.

This analysis does not necessarily address the full suite of actions needed to maintain the current distribution and connectivity of sage-grouse habitats across the Great Basin because resources available to the federal agencies are limited at this time. Future efforts designed to maintain and connect habitats across the range will be needed as current focal areas are addressed and additional resources become available.

Step 1 – Sage-Grouse Landscape Context

Wildfire/Invasive Annual Grass Threat

- Priority Areas for Conservation
- 75% Breeding Bird Density Areas
- Sagebrush Landscape Cover
- Resistance to invasive annual grasses and resilience to disturbance

Conifer Expansion Threat

- Priority Areas for Conservation
- 75% Breeding Bird Density Areas
- Sagebrush Landscape Cover
- Conifer Expansion Map

Step 1a - Select Priority Areas for Conservation and focal habitats

Priority Areas for Conservation: Figure 6, Tables 1 &2

Focal habitats: Figure 6 and Table 2

Emphasis areas are habitats where resistance to invasive annual grasses and resiliency after disturbance are low within and around focal habitats.

Priority Areas for Conservation: Figure 7, Tables 3&4

Focal habitats: Figure 7 and Table 4

Emphasis areas are conifer expansion in association with 75% Breeding Bird Density areas with landscape sagebrush cover greater tjam 25%

Step 1b. Potential Management Strategies and Examples

Management Strategies to Address Wildfires and Invasive Annual Grasses
- Habitat Recovery/Restoration
- Fuels Management
- Fire Operations
- Post-Fire Rehabilitation

Utilize Table 4 in Chambers et al. 2014 to develop management strategies for each Priority Area for Conservation.

Management Strategies to Address Conifer Expansion
- Habitat Recovery/Restoration
- Fuels Management
- Fire Operations
- Post-Fire Rehabilitation

Utilize Table 4 in Chambers et al. 2014 to develop management strategies for each Priority Area for Conservation.

Step 2 – Management Unit Applications for Invasive Annual Grasses and Conifer Expansion

Step 2a

1) Evaluate the accuracy and utility of Step 1 geospatial layers and incorporate relevant local information.
2) Develop framework for incorporating management strategies to initiate implementation/activity plans.

Step 2b

Develop collaborative implementation/activity plans to address threats to focal habitats in Priority Areas for Conservation.

Figure 1, Assessment Flow Chart

Step 1

The first component of the Wildfire and Invasive Annual Grasses Assessment describes the factors that collectively provide the sage-grouse landscape context. Step 1a provides this context by discussing PACs, breeding bird density (BBD), soil temperature and moisture regimes (indicators of resistance to annual grasses and resilience after disturbance), landscape sagebrush cover, and conifer expansion. See Chambers et al. 2014) for a detailed description of Invasive Annual Grass and Wildfire threats to sage-grouse habitat. Priority PACs and focal habitats are derived from the information provided in this sage-grouse landscape context section.

Step 1a- Sage-grouse landscape context

This component of the assessment identifies important PACs and associated focal habitats where wildfire, invasive annual grasses, and conifer expansion pose the most significant threats to sage-grouse.

The primary focus of this assessment is on sage-grouse populations across the WAFWA Management Zones III, IV, and V (**Figure 2**, Current PACs for WAFWA Management Zones III, IV, and V). Sage-grouse are considered a landscape species that require very large areas to meet their annual life history needs. Sage-grouse are highly clumped in their distribution (Doherty et al. 2010), and the amount of landscape cover in sagebrush is an important predictor of sage-grouse persistence in these population centers (Knick et al. 2013). States have used this information combined with local knowledge to identify PACs to help guide long-term conservation efforts. FIAT used data sets that were available across the three management zones as an initial step for prioritizing selected PACs and identifying focal habitats for fire and invasive annual grasses and conifer expansion assessments. These data sets (also described in Chambers et al. 2014) include:

Priority Areas for Conservation (PACs)

PACs have been identified by states as key areas that are necessary to maintain redundant, representative, and resilient sage-grouse populations (USFWS 2013; see Figure 2). A primary objective is to minimize threats within PACs (e.g., wildfire and invasive annual grasses impacts) to ensure the long-term viability of sage-grouse and its habitats. A secondary priority is to conserve sage-grouse habitats outside of PACs since they may also be important for habitat connectivity between PACs (genetic and habitat linkages), habitat restoration and population expansion opportunities, and flexibility for managing habitat changes that may result from climate change. PACs have also been identified by the USFWS as one of the reporting geographic areas that will be considered during listing determinations for sage-grouse.

The combination of PACs with BBD data (described below) assists us in identifying connectivity between populations. PAC boundaries may be modified in the future requiring adjustments in focal habitat areas and management strategy priorities.

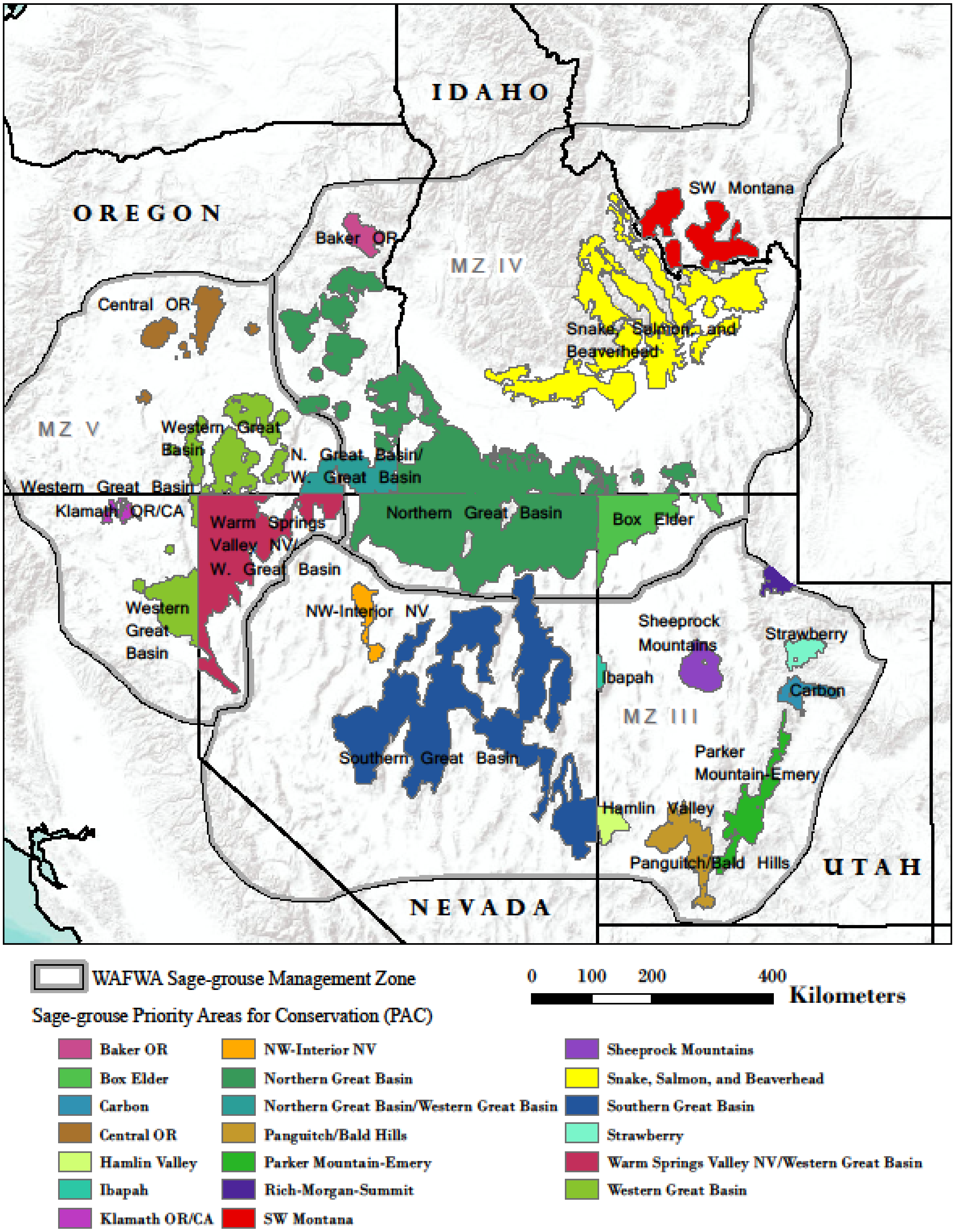

Figure 2, Current PACs for WAFWA Management Zones III, IV, and V. Bi-State sage-grouse populations were not included for this analysis and are being addressed in separate planning efforts.

Breeding Bird Density

Doherty et al. (2010) provided a useful framework for identifying population concentration centers in their range-wide BBD mapping. FIAT used maximum counts of males on leks (4,885 males) to delineate breeding bird density areas that contain 25, 50, 75, and 100 percent of the known breeding population. Leks were then mapped according to abundance values and buffered by 4 to 5.2 miles (6.4 to 8.5 kilometers) to delineate nesting areas. Findings showed that while sage-grouse occupy extremely large landscapes, their breeding distribution is highly aggregated in comparably smaller identifiable population centers; 25 percent of the known population occurs within 3.9 percent (7.2 million acres [2.92 million hectares]) of the species range, and 75 percent of birds are within 27 percent of the species range (50.5 million acres [20.4 million hectares]; Doherty et al. 2010). See **Figures 3**, Sage-Grouse Breeding Bird Density Thresholds.

This analysis places emphasis on breeding habitats because little broad/mid-scale data exists for associated brood-rearing (summer) and winter habitat use areas. Finer scale seasonal habitat use data should be incorporated (or, if not available studies, should be conducted) at local levels to ensure management actions encompass all seasonal habitat requirements. Federal administrative units should consult with state wildlife agencies for additional seasonal habitat information.

For this assessment, FIAT chose to use the 75 percent BBD as an indicator of high bird density areas that informed the approach used by state wildlife agencies to initially identify PACs. Range-wide BBD areas provide a means to further prioritize actions within relatively large PACs to maintain bird distribution and abundance. FIAT used state level BBD data from Doherty et al. (2010) instead of range-wide model results to ensure important breeding areas in Management Zones III, IV, and V were not underweighted due to relatively higher bird densities in the eastern portion of the range. BBD areas of 75 to 100 percent are included in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

Note that breeding density areas were identified using best available information in 2009, so this range-wide data does not reflect the most current lek count information and changes in conditions since the original analysis. Subsequent analysis should use the most current information available. Also, BBD areas should not be viewed as rigid boundaries but rather as a means to regionally prioritize landscapes where step down assessments and actions should be implemented quickly to conserve the most birds.

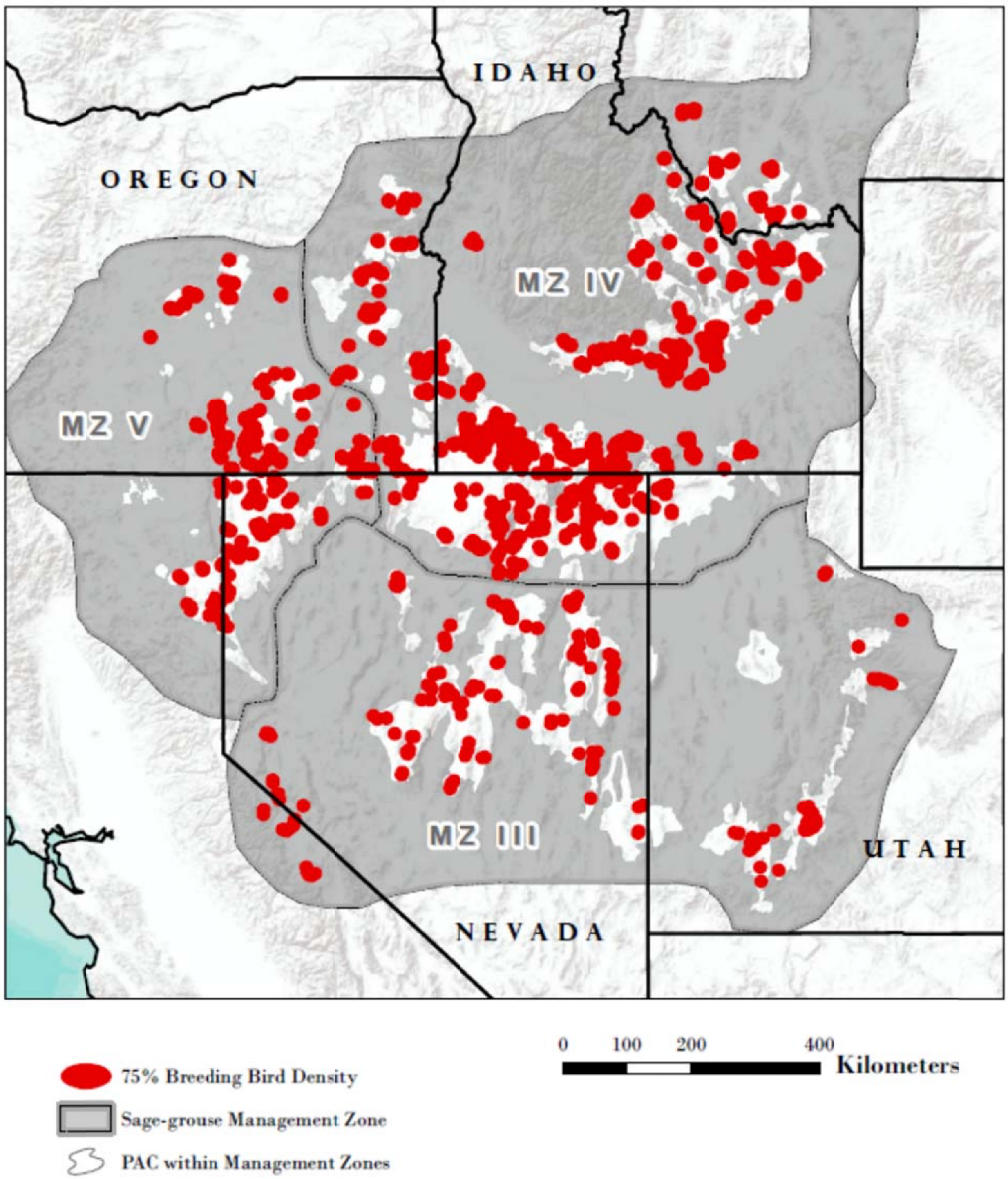

Figure 3, Sage-Grouse Breeding Bird Density Thresholds for 75% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is shown in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

Soil Temperature and Moisture Regimes

Invasive annual grasses and wildfires can be tied to management strategies through an understanding of resistance and resilience concepts. Invasive annual grasses has significantly reduced sage-grouse habitat throughout large portions of its range (Miller et al. 2011). While abandoned leks were linked to increased nonnative annual grass presence, active leks were associated with less annual grassland cover than in the surrounding landscape (Knick et al. 2013). Invasive annual grasses also increases fire frequency, which directly threatens sage-grouse habitat and further promotes the establishment of invasive annual grasses (Balch et al. 2013). This nonnative annual grass and fire feedback loop can result in conversion from sagebrush shrublands to annual grasslands (Davies 2011).

In cold desert shrublands, vegetation community resistance to invasive annual grasses and resilience following disturbance is strongly influenced by soil temperature and moisture regimes (Chambers et al. 2007; Meyer et al. 2001). Generally, colder soil temperature regimes and moister soil moisture regimes are associated with more resilient and resistant vegetation communities. While vegetation productivity and ability to compete and recover from disturbance increase along a moisture gradient, cooler temperatures limit invasive annual grass growth and reproduction (Chambers et al. 2007; Chambers et al. 2014). Conversely, warm and dry soil temperature and moisture regimes and to a lesser degree cool and dry soil temperature and moisture regimes, are linked to less resistant and resilient communities (see Figure 9 in Chambers et al. 2014). A continuum in resistance and resilience exists between the warm and dry and cool and dry soil temperature and moisture regimes that will need to be considered in Step 2 in developing implementation or activity plans. These relationships can be used to prioritize management actions within sage-grouse habitat using broadly available data.

To capture relative resistance and resilience to disturbance and invasive annual grasses across the landscape, soil temperature and moisture regime information (described in greater detail in Chambers et al. 2014) were obtained from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) data. Where gaps in this coverage existed, the NRCS US General Soil Map (STATSGO2) data was used (Soil Survey Staff 2014; see Appendix 1). The STATSGO2 database includes soils mapped at a 1:250,000-scale; the SSURGO database includes soils mapped at the 1:20,000 scale. Interpretations made from soil temperature and moisture regimes from the STATSGO2 database will not have the same level of accuracy as those made from the SSURGO database.

Areas characterized by warm and dry soil temperature and moisture regimes (low relative resistance and resilience) were intersected with sage-grouse breeding habitat and sagebrush landscape cover to identify candidate areas (emphasis areas) for potential management actions that mitigate threats from invasive annual grasses and wildfire (**Figure 4**, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V, and **Figure 5**, Intersection of High Density (75% BBD) Populations). These data layers provide the baseline information considered important in prioritizing areas where conservation and management actions could be developed to address invasive annual grasses in a scientifically defensible manner (see Table 4 in Chambers et al. 2014).

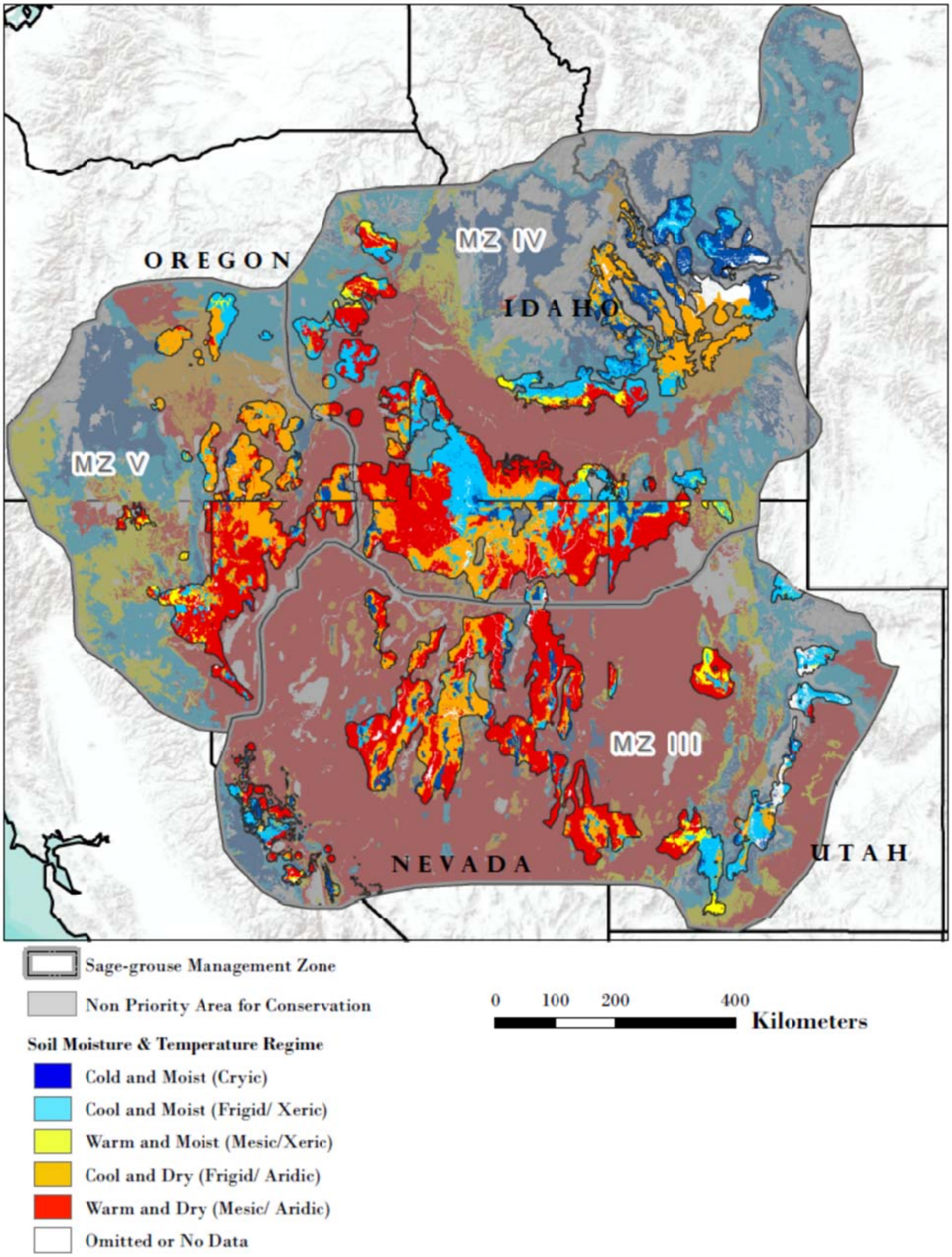

Figure 4, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V

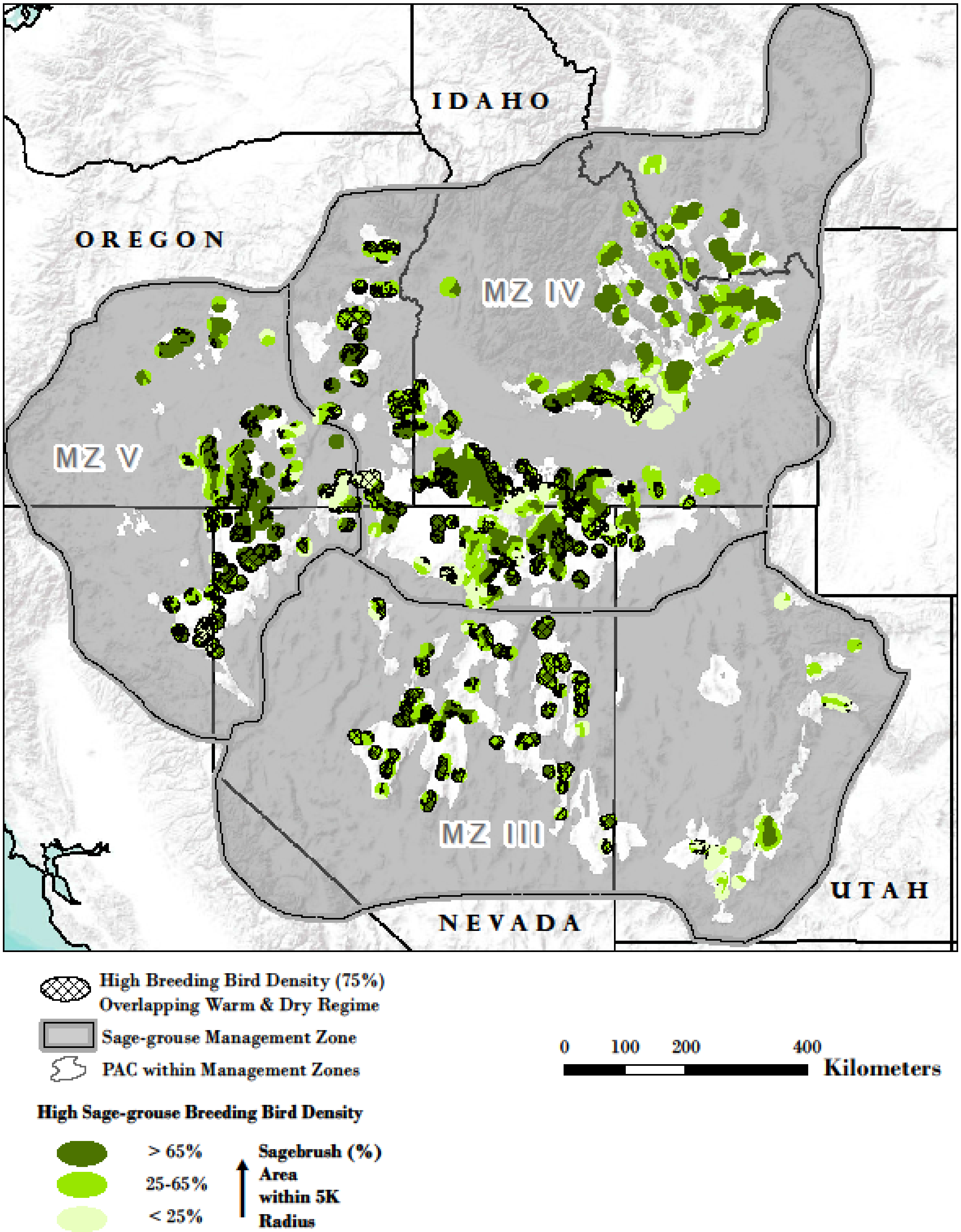

Figure 5, Intersection of High Density (75% BBD) Populations. The warm and dry sites and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin.

Sagebrush Landscape Cover

The amount of the landscape in sagebrush cover is closely related to the probability of maintaining active sage-grouse leks, and is used as one of the primary indicators of sage-grouse habitat potential at landscape scales (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). For purposes of prioritizing landscapes for sage-grouse habitat management, FIAT used less than or equal to 25 percent sagebrush landscape cover as a level below which there is a low probability of maintaining sage-grouse leks, and greater than or equal to 65 percent as the level above which there is a high probability of sustaining sage-grouse populations with further increases of landscape cover of sagebrush (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Increases in landscape cover of sagebrush have a constant positive relationship with sage-grouse lek probability at between about 25 percent and 65 percent landscape sagebrush cover (Knick et al. 2013). It is important to note that these data and interpretations relate only to persistence (i.e., whether or not a lek remains active), and it is likely that higher proportions of sagebrush cover may be required for population growth.

For the purposes of delineating sagebrush habitat relative to sage-grouse requirements for landscape cover of sagebrush, FIAT calculated the percentage of landscape sagebrush cover (Landfire 2013) within a 3-mile (5-kilometer) radius of each 98-foot by 98-foot (30 meter by 30 meter) pixel in Management Zones III, IV, and V (see Appendix 2 in Chambers et al. 2014) for how landscape sagebrush cover was calculated). FIAT then grouped the percentage of landscape sagebrush cover into each of the selected categories (0 to 25 percent, 25 to 65 percent, 65 to 100 percent; **Figure 6**, Sagebrush Landscape Cover and Fire Perimeters for the Analysis Area). Landfire data was based on 2000 satellite imagery so wildfire perimeters after that date were incorporated into this layer to better reflect landscape sagebrush cover. Burned areas were assumed to fall into the 0 to 25 percent landscape cover class.

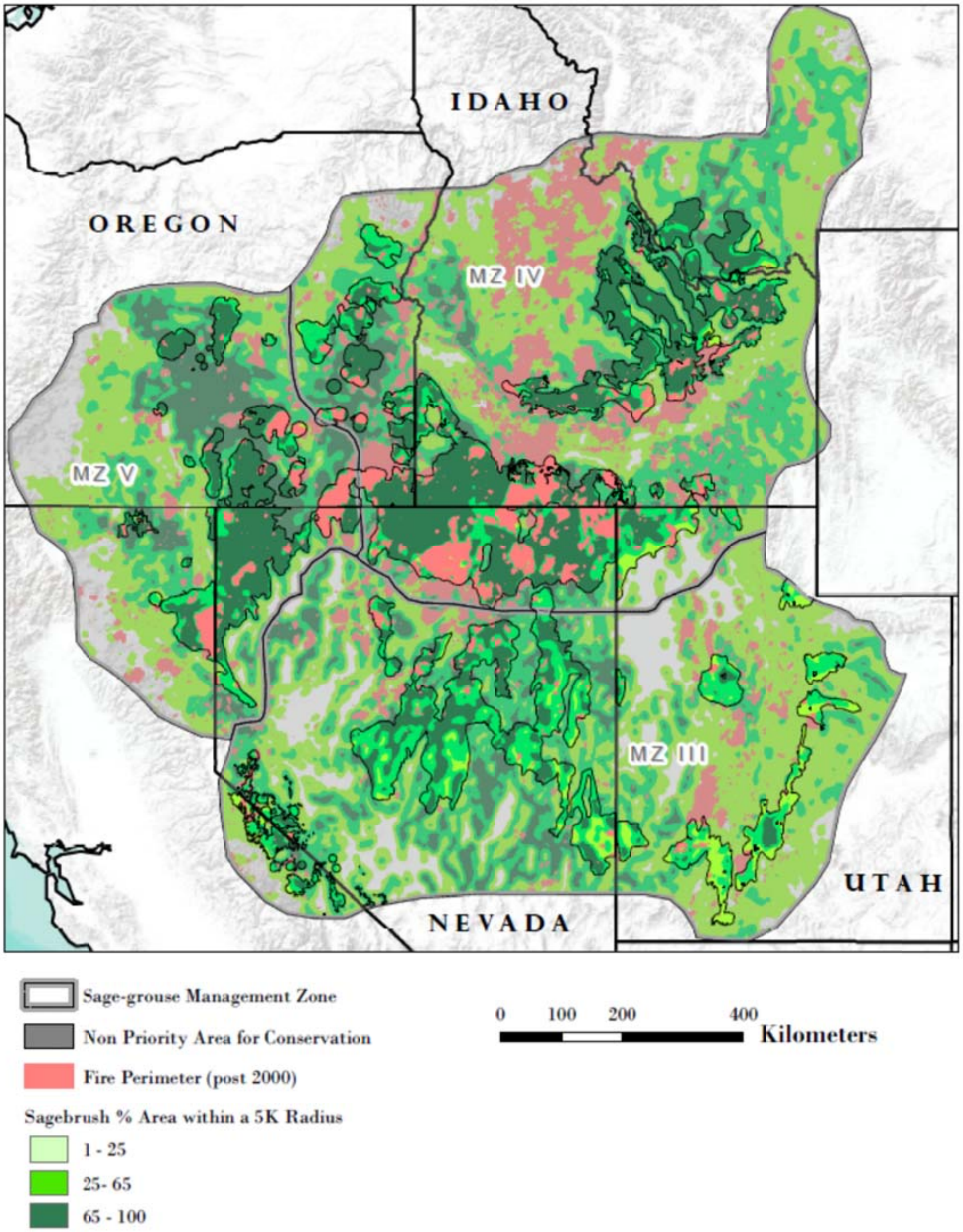

Figure 6, Sagebrush Landscape Cover and Fire Perimeters (post-2000) for the Analysis Area

Conifer Expansion

Conifer expansion into sagebrush landscapes also directly reduces sage-grouse habitat by displacing shrubs and herbaceous understory as well as by providing perches for avian predators. Conifer expansion also leads to larger, more severe fires in sagebrush systems by increasing woody fuel loads (Miller 2013). Sage-grouse populations have been shown to be impacted by even low levels of conifer expansion (Baruch-Mordo et al. 2013). Active sage-grouse leks persist in regions of relatively low conifer woodland and are threatened by conifer expansion (Baruch-Mordo et al. 2013; Knick et al. 2013).

To estimate where sage-grouse breeding habitat faces the largest threat of conifer expansion, FIAT used a risk model developed by Manier et al. (2013) that locates regions where sagebrush landscapes occur within 250 meters of conifer woodland (**Figure 7**, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD). Although the model is coarse, it is available for the entirety of the three sage-grouse management zones analyzed. FIAT encourages using more accurate conifer expansion data in Step 2.

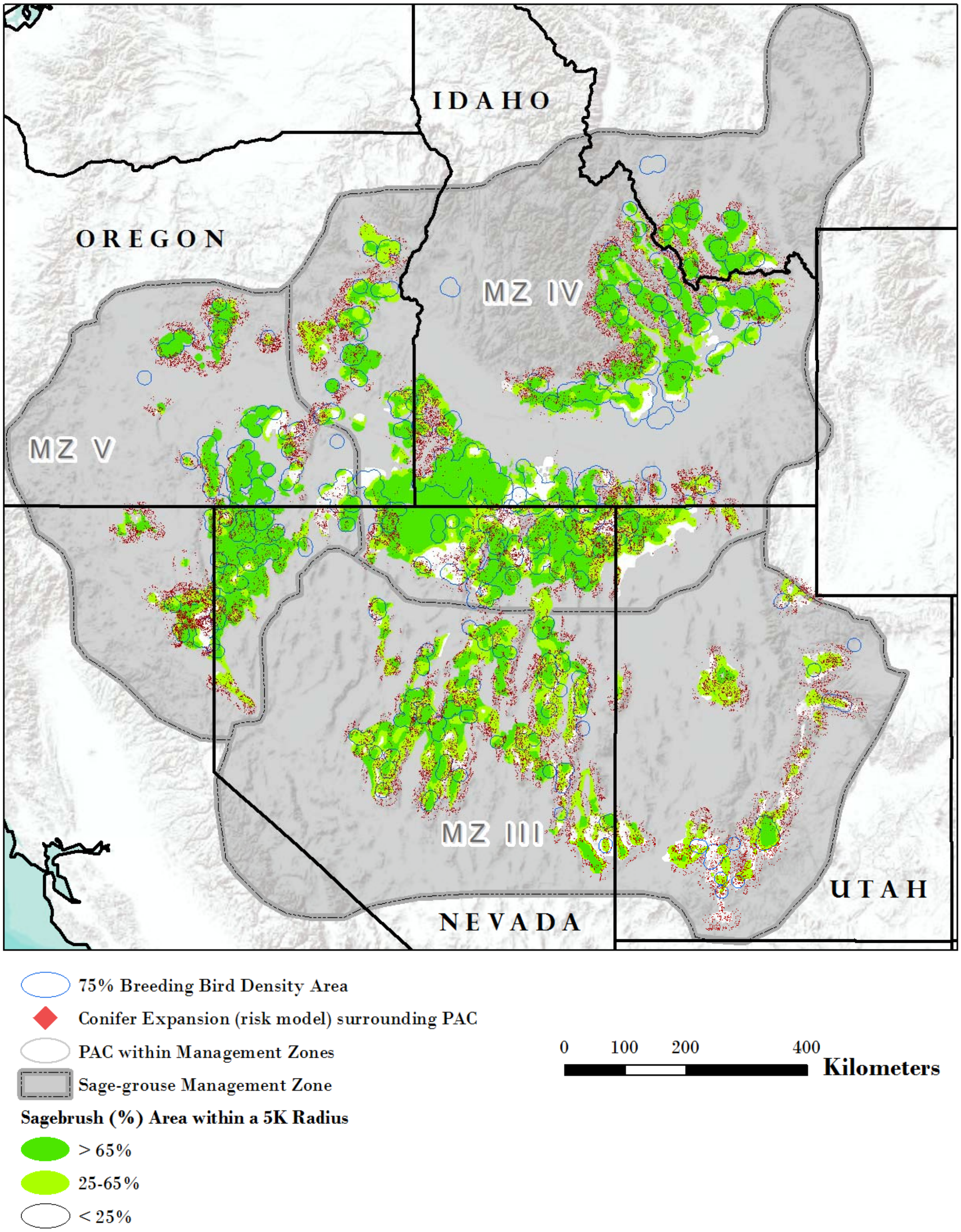

Figure 7, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD

Step 1a. Identifying PACs and focal habitats

A primary goal for the conservation of sage-grouse populations is the identification of important habitats needed to ensure the persistence and recovery of the species. Loss of habitat, and by inference populations, in these habitats would likely imperil the species in the Great Basin. The first objective is to protect and restore those habitats that provide assurances for retaining large well connected populations.

PACs and the 75 percent BBD maps were used to provide a first-tier stratification (e.g., focal habitats) for prioritizing areas where conservation actions could be especially important for sage-grouse populations. Although these areas are a subset of the larger sage-grouse habitats, they are readily identifiable and include habitats (e.g., breeding and nesting habitats that are considered critical for survival; Connelly et al. 2000; Holloran et al. 2005; Connelly et al. 2011) and necessary for the recovery of the species across its range.

The prioritization of habitats for conservation purposes was based on the several primary threats to remaining sage-grouse populations in the Great Basin including the loss of sagebrush habitats to wildfire and invasive annual grasses, and conifer expansion. The first, and probably the most urgent threat for sage-grouse, is the loss of sagebrush habitat due to wildfire and invasive annual species (e.g., cheatgrass; See Figure 11 in Chambers et al. 2014). Areas of highest concern are those with low resistance to cheatgrass and low resilience after disturbance (warm/dry and some cool/dry temperature and moisture regimes sites) that are either **within or in close proximity** to remaining high density populations of sage-grouse (Figure 5). Sagebrush habitats (greater than 25 percent sagebrush landscape cover) prone to conifer expansion, particularly pinyon pine and/or juniper, are also a management concern when within or adjacent to high density sage-grouse populations (Figure 7).

Because these two threats occur primarily at different points along an elevational gradient and are associated with different soil temperature and moisture regimes, separate approaches are used to select PACs and focal habitats for each.

High Density Populations at Highest Risk from <u>Wildfire and Invasive Annual Grasses</u>
PACs in Management Zones III, IV, and V. were evaluated on the basis of high density (75 percent) BBDs, sagebrush landscape cover, and soil temperature and moisture regimes to identify initial PACs that are a priority for assessments and associated focal habitats. **Figure 8**, High Priority PACs with High Density Sage-Grouse Populations (75% BBD), displays the results of the analysis focusing on the intersection of high density (75 percent BBD) populations, the warm and dry sites, and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin. **Table 1**, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes, displays quantitative outputs of this analysis. The table allows a comparison of these data, and assists in selecting five PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with warm and dry soil temperature and moisture regimes.

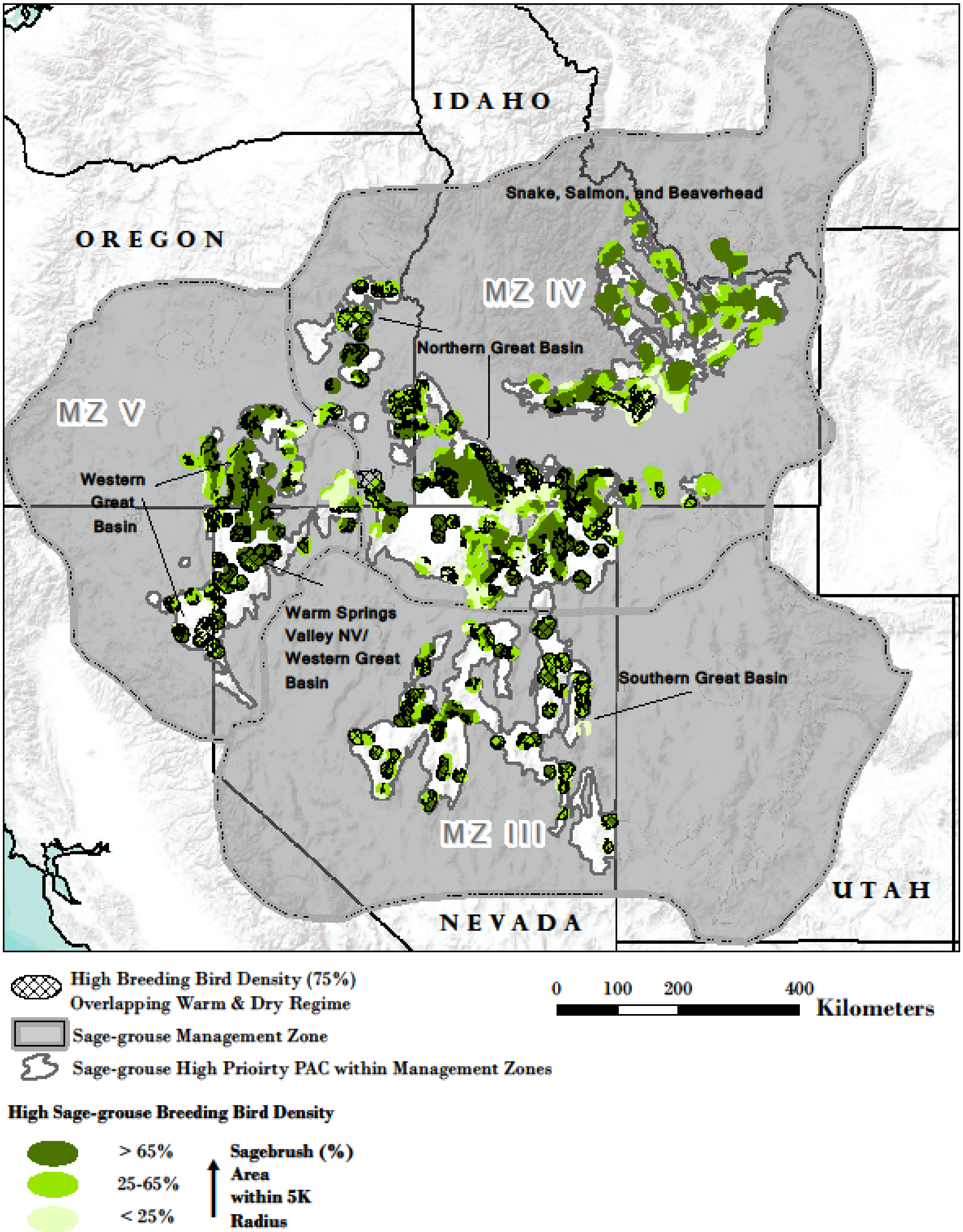

Figure 8, High Priority PACs with High Density Sage-Grouse Populations (75% BBD) sagebrush landscape cover classes, and areas with low resistance and resilience relative to wildfires and invasive annual species.

Table 1, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes

Sage-grouse Management Zone	Sage-grouse Priority Area for Conservation (PAC) Name	Total PAC Acres	Breeding Bird Density (75%) Acres	Percent of Breeding Bird Density (75%) Area within PAC	Warm and Dry Soil Moisture & Temperature Regime within Breeding Bird Density (75%) Acres*		
					0-25% Sagebrush Landscape Cover	25%-65% Sagebrush Landscape Cover	65%+ Sagebrush Landscape Cover
4	Northern Great Basin	13045515	7383442	57%	179551 (2%)	674554 (9%)	1745163 (24%)
3	Southern Great Basin	9461355	3146056	33%	42596 (1%)	792780 (25%)	1062091 (34%)
4	Snake, Salmon, and Beaverhead	5477014	2823205	52%	68107 (2%)	89146 (3%)	95970 (3%)
5	Western Great Basin	3177253	2084626	66%	149399 (7%)	140141 (7%)	202767 (10%)
5	Warm Springs Valley NV/Western Great Basin	3520937	1558166	44%	31458 (2%)	207365 (13%)	741353 (48%)
4	SW Montana	1369076	659475	48%	0 (0%)	0 (0%)	0 (0%)
4	Northern Great Basin/Western Great Basin	1065124	624581	59%	114222 (18%)	85258 (14%)	116513 (19%)
5	Central OR	813699	451755	56%	0 (0%)	6211 (1%)	16463 (4%)
3	Panguitch/Bald Hills	1135785	352258	31%	6883 (2%)	5821 (2%)	0 (0%)
3	Parker Mountain-Emery	1122491	308845	28%	0 (0%)	127 (0%)	0 (0%)
4	Box Elder	1519454	292658	19%	22 (0%)	43325 (15%)	23913 (8%)
4	Baker OR	336540	184813	55%	0 (0%)	46459 (25%)	36214 (20%)
3	NW-Interior NV	371557	108256	29%	576 (1%)	17117 (16%)	25173 (23%)
3	Carbon	355723	97734	27%	255 (0%)	180 (0%)	0 (0%)
3	Strawberry	323219	52635	16%	0 (0%)	0 (0%)	0 (0%)
3	Rich-Morgan-Summit	217033	37005	17%	0 (0%)	0 (0%)	0 (0%)
3	Hamlin Valley	341270	3244	1%	0 (0%)	139 (4%)	3105 (96%)
3	Ibapah	98574	0	0%	0 (NA)	0 (NA)	0 (NA)
3	Sheeprock Mountains	611374	0	0%	0 (NA)	0 (NA)	0 (NA)
5	Klamath OR/CA	162667	0	0%	0 (NA)	0 (NA)	0 (NA)

* Numbers in parenthesis indicate the percent of acres relative to total acres of breeding bird density (75%)

These five PACs comprise 90 percent and 95 percent of remaining PAC sagebrush landscape cover in the 25 to 65 percent and greater than or equal to 65 percent sagebrush landscape cover classes, respectively, of the 75 percent BBD associated with low resistance/resilience habitats. The 75 percent BBD habitats in the Northern, Southern Great Basin, and Warm Spring PACs appear particularly important for two reasons. They represent a significant part of the remaining habitats for the Great Basin metapopulation, and they have the greatest amount of low resiliency habitat remaining that still functions as sage-grouse habitat.

An examination of the 5 selected PACs shows that the sum of the 75 percent BBD within these PACs is 16,995,496 acres (**Table 2**, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class). These are the **focal habitats**. These five PACs constitute 84 percent of the 75 percent BBD low resiliency habitats for all Management Zones III, IV, and V PACs. Within and immediately around these focal habitats, 5,751,293 acres are in high BBD areas with landscape sagebrush cover in the 25-65 percent and ≥ 65 percent classes and in the warm and dry soil temperature and moisture regimes. These are the habitats in the most danger to loss due to their low resistance to invasive annual grasses and low resilience following wildfire. Within the focal habitats in the high priority PACs, low resistance and resilience areas (cross-hatched areas in Figure 8) are a high priority (emphasis area) for implementing management strategies. Applying management strategies outside the emphasis areas are appropriate if the application of fire operations and fuels management activities will be more effective in addressing wildfire threats.

Table 2, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class (see Figure 8)

PAC	PAC Acres	Acres of 75% BBD in PAC (**focal habitat**)	Proportion of 75% BBD within PACs	Warm & Dry Soils within 75% BBD by Sagebrush Landscape Cover Classes Greater Than 25%*	
				25-65%	>65%
Northern Great Basin	13,045,515	7,383,442	0.57	674,517(9%)	1,745,163(24%)
Southern Great Basin	9,461,355	3,146,056	0.33	792,780(25%)	1,062,091(34%)
Snake, Salmon, and Beaverhead	5,477,014	2,823,205	0.52	89,146(3%)	95,970(3%)
Warm Springs Valley NV/Western Great Basin	3,520,937	1,558,166	0.44	207,365(13%)	741,353(48%)
Western Great Basin	3,177,253	2,084,626	0.66	140,141(7%)	202,767(10%)
Total for 5 PACS	**34,682,074**	**16,995,496**	**0.49**	**1,903,949**	**3,847,344**

***** This category represents the emphasis areas for applying appropriate management strategies in or near the focal habitats due to the lower probability of recovery after disturbance and higher probability of invasive annual grasses and existing wildfire threats.

High Density Sage-Grouse Habitats at Risk from Conifer Expansion

PACs, sagebrush landscape cover, and the 75 percent BBD data were also used in conjunction with the conifer expansion data (Mainer et al. 2013) to provide an initial stratification to determine PACs where conifer removal would benefit important sagebrush habitats. Conifer expansion threats are primarily western juniper in the northern Great Basin and pinyon pine/Utah juniper in the southern Great Basin.

Figure 7 displays results of the analysis focusing on the intersection of the 75 percent BBD, and modeled conifer expansion areas within two sagebrush landscape cover classes by management zone and PACs within the Great Basin. To identify high density sage-grouse areas affected by conifer expansion, the amount and proportion of acres estimated to be affected were calculated by sagebrush cover class to assist in the identification of the focal habitats (**Table 3)**. **Table 4**, displays quantitative outputs of this analysis using the 25 to 65 percent and greater than 65 percent landscape sagebrush cover classes for the PACs. Thus, **focal habitats** for addressing conifer expansion are the areas within and near conifer expansion in sagebrush landscape cover classes of 25 to 65 percent and greater than 65 percent. Conifer expansion in these two sagebrush landscape cover classes in the 75 percent BBD areas constitutes an emphasis area for treatments to address conifer expansion. Landscapes with less than 25 percent sagebrush cover may require significant additional management actions to restore sagebrush on those landscapes and therefore were considered a lower priority for this analysis. Focal habitats are identified in Table 4 and displayed in **Figure 9**.

Table 3 assists in identifying those PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with modelled conifer expansion areas. Although there are uncertainties associated with the model, the results help managers identify specific geographic areas where treatments in conifer (pinyon and/or juniper) could benefit existing important sage-grouse populations.

The results of the screening revealed 5 PACs that contribute substantially to the 75 percent BBD habitats and are currently impacted most by conifer expansion (primarily pinyon pine and/or juniper; Table 4 and Figure 9). Four of the five PACs identified as high priority for conifer expansion treatments were also high priorities for wildfires and invasive annual grass threats. This is likely due to the size of the PACs and the relative importance of these PACs for maintaining the Great Basin sage-grouse meta-populations. As expected, the locations of high density sage-grouse habitats affected by conifer expansion differ spatially from those associated with low resilience habitats within and among the PACs, primarily due to differences in the biophysical settings (e.g., elevation and rainfall) that contribute to threats from invasive annual grasses and wildfires.

Three PACs (Snake/Salmon/Beaverhead, Southwest Montana, and Northern Great Basin/Western Great Basin) ranked high due to their relatively large proportion of high density breeding habitats (Table 3), but were not selected since the threat of conifer expansion was relatively low. One PAC, (Snake/Salmon/Beaverhead, was identified as a potential high priority area but was dismissed because results of the conifer expansion model likely overestimated impacts due to the adjacent conifer forests in this region. The COT Report also identified conifers as a “threat present but localized” in these areas, whereas, the top five PACs prioritized all have conifers identified as a widespread priority threat to address (USFWS 2013).

Table 3, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Modeled Conifer Expansion, and Percentage of Habitats in Sagebrush Landscape Cover Classes

Sage-grouse Management Zone	Sage-grouse Priority Area for Conservation (PAC) Name	PAC acres	Breeding Bird Density (75%) Acres	Relative Proportion of Breeding Bird Density Area within PAC	Conifer Expansion (Modeled) Acres*		
					0-25% Sagebrush Landscape Cover	25%-65% Sagebrush Landscape Cover	65%+ Sagebrush Landscape Cover
4	Northern Great Basin	13045515	7383442	0.57	188502 (1%)	512949 (4%)	442480 (3%)
3	Southern Great Basin	9461355	3146056	0.33	108657 (1%)	738624 (8%)	237828 (3%)
4	Snake, Salmon, and Beaverhead	5477014	2823205	0.52	4209 (0%)	92173 (2%)	216803 (4%)
5	Western Great Basin	3177253	2084626	0.66	87963 (3%)	184618 (6%)	126177 (4%)
5	Warm Springs Valley NV/Western Great I	3520937	1558166	0.44	37148 (1%)	107025 (3%)	217101 (6%)
4	SW Montana	1369076	659475	0.48	1428 (0%)	34765 (3%)	39215 (3%)
4	Northern Great Basin/Western Great Bas	1065124	624581	0.59	12101 (1%)	2247 (0%)	6161 (1%)
5	Central OR	813699	451755	0.56	3191 (0%)	44937 (6%)	59624 (7%)
3	Panguitch/Bald Hills	1135785	352258	0.31	89141 (8%)	75157 (7%)	2563 (0%)
3	Parker Mountain-Emery	1122491	308845	0.28	84719 (8%)	83441 (7%)	7469 (1%)
4	Box Elder	1519454	292658	0.19	8531 (1%)	114376 (8%)	57645 (4%)
4	Baker OR	336540	184813	0.55	945 (0%)	15263 (5%)	195 (0%)
3	NW-Interior NV	371557	108256	0.29	7929 (2%)	29440 (8%)	11813 (3%)
3	Carbon	355723	97734	0.27	15968 (4%)	34446 (10%)	283 (0%)
3	Strawberry	323219	52635	0.16	7916 (2%)	27340 (8%)	1075 (0%)
3	Rich-Morgan-Summit	217033	37005	0.17	11685 (5%)	14280 (7%)	238 (0%)
3	Hamlin Valley	341270	3244	0.01	11321 (3%)	29960 (9%)	6243 (2%)
3	Ibapah	98574	0	0.00	195 (0%)	6770 (7%)	1039 (1%)
5	Klamath OR/CA	162667	0	0.00	1 (0%)	1533 (1%)	15302 (9%)
3	Sheeprock Mountains	611374	0	0.00	16744 (3%)	78580 (13%)	11878 (2%)

* Numbers in parenthesis indicate the proportion of acres relative to total PAC acres

Table 4, PACS with the Highest Acres and Proportions of 75% BBD acres and Estimated Conifer Expansion within Sagebrush Landscape Cover Classes (25-65 percent and ≥65 percent; see Figure 9)

PAC	PAC Acres	Acres 75% BBD in PAC	Prop. 75% BBD within PACs	Conifer Expansion by Landscape Sagebrush Cover Classes 25-65% and ≥65%* Focal Habitat	
				25-65%	≥65%
Northern Great Basin	13,045,515	7,383,442	0.57	512,949 (4%)	442,480 (3%)
Southern Great Basin	9,461,355	3,146,056	0.33	738,624 (8%)	237,828 (3%)
Warm Springs Valley NV/Western Great Basin	3,520,937	1,558,166	0.44	107,025 (3%)	217,101 (6%)
Western Great Basin	3,177,253	2,084,626	0.66	184,618 (6%)	126,177 (4%)
Central Oregon	813,699	451,755	0.56	44,937 (6%)	59,624 (7%)
Total for 5 PACS	**30,018,759**	**14,624,045**	**0.49**	**1,588,153 (5%)**	**1,083,210 (4%)**

*Numbers in parenthesis represent the percent of total PAC acres for each class.

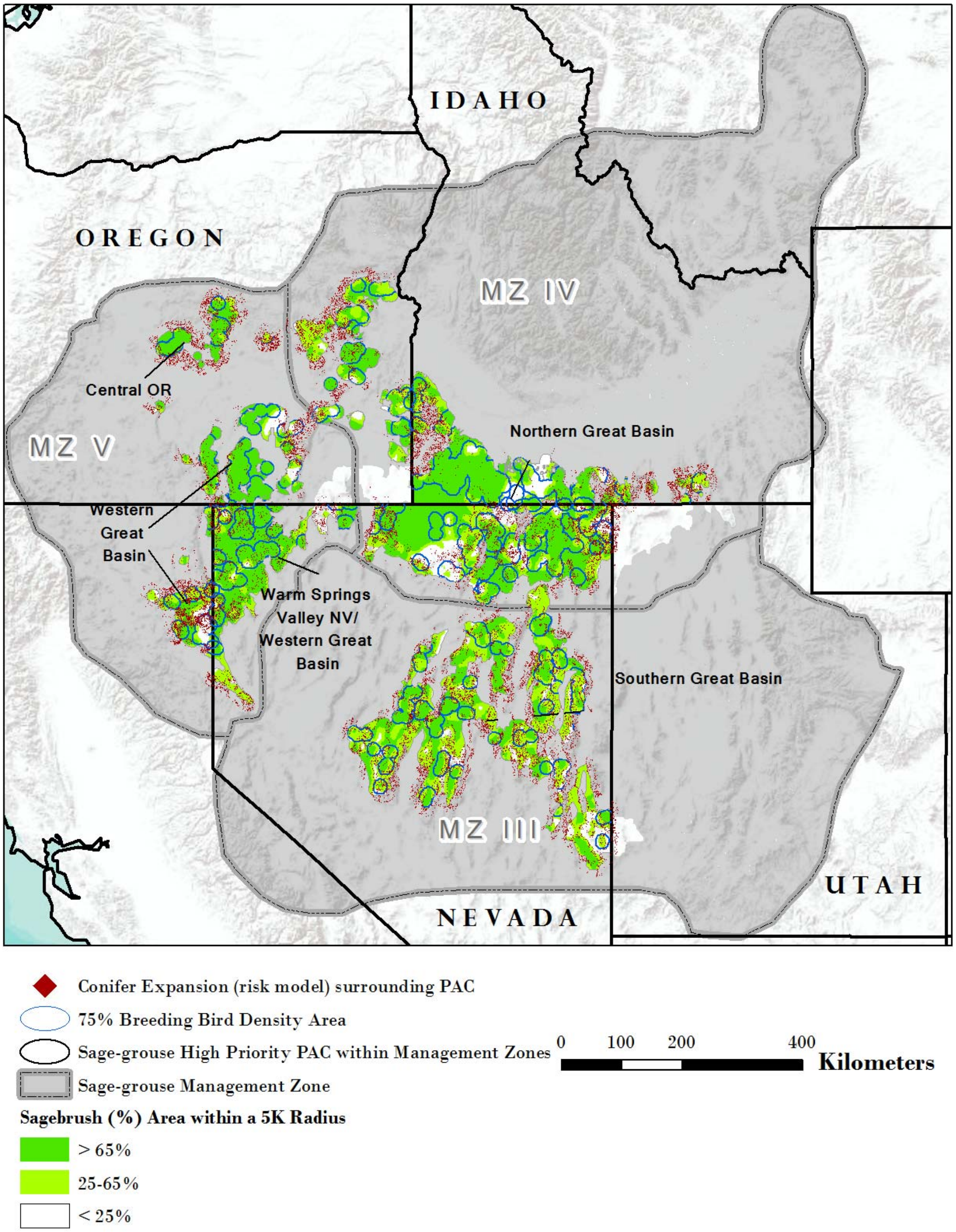

Figure 9, Five PACs Significantly Impacted by Conifer Expansion that contribute substantially to the 75% BBD and that have sagebrush landscape cover greater than 25%.

While the coarse-scale conifer expansion data used in this analysis likely over estimates the extent of the pinyon pine and/or juniper threat, results suggest that far fewer acres are currently affected by conifers than might be at risk from fire and invasive annual grasses impacts. Conifer expansion into sage-grouse habitats occurs at a slower rate, allowing more time for treatment, but early action may be needed to prevent population level impacts on sage-grouse (Baruch-Mordo et al. 2013). Furthermore, conifer expansion is primarily occurring on cooler and moister sites that are more resilient and where restoration is more likely to be effective (Miller et al. 2011), providing managers the opportunity to potentially offset at least some habitat loss expected to continue in less resilient ecosystems. While the available data set used to estimate conifer expansion provides only a coarse assessment of the problem, considerable efforts are currently underway to map conifers across sage-grouse range. These maps are expected to be available in the near future and should be used by land managers to better target project level conifer removal.

FIAT cautions against using the plotted locations of estimated conifer expansion for local management decisions due to the coarse-scale nature of this range-wide data set. Conifer expansion estimates are primarily provided here to aid in judging the relative scope of the threat in each PAC.

Step 1b. Potential Management Strategies

Potential management **strategies** (e.g., fuels management, habitat recovery/restoration, fire operations, post-fire rehabilitation) to conserve or restore Step 1 focal habitats are described below to assist local management units to initiate Step 2. These examples are illustrative and do not contain the full range of management strategies that may be required to address wildfires, invasive annual grasses, and conifer expansion within PACs and associated focal habitats. In general, the priority for applying management strategies is to first maintain or conserve intact habitat and second to strategically restore habitat (after a wildfire or proactively to reconnect habitat). Management strategies will differ when applying the protocol to:

Wildfire and Invasive Annual Grass. (See PACs identified in Table 2 and focal habitats shown in Figure 8). Focal habitats, as they relate to wildfires and invasive annual grasses, are defined as sage-grouse habitat in priority PACs within 75 percent BBD. Within these focal habitats, sagebrush communities with low resilience to disturbance and resistance to invasive annual grasses (warm and dry soil temperature and moisture regimes) are an emphasis area for management actions. Appendix 5 (A) in Chambers et al. 2014) includes a generalized state and transition model with an invasive annual grass component and warm and dry soil temperature and moisture regime associated with 8 to 12 inches of annual precipitation. This state and transition models is useful in developing management strategies to deal with annual grass issues as it contains useful restoration pathways.

Burn Probability is another tool that can be used to assist managers to identify the relative likelihood of large fire occurrence across the landscape within PACs and focal habitats. Burn probability raster data were generated by the Missoula Fire Lab using the large fire simulator - FSim - developed for use in the national Interagency **Fire Program Analysis (FPA)** project. FSim uses historical weather data and LANDFIRE fuel model data to simulate fires burning. Using these simulated fires, an overall burn probability is returned by FSim for each 270m pixel. The burn probability data was overlaid spatially with PACs, soil data, and shrub cover data. The majority of the high and very high burn probability acres lie within the top 5 PACs and are within areas with >25% sagebrush cover. Several of the other PACs have a greater overall percentage of the warm/dry soil regime with high/very high burn probability (northern great basin, baker, and NW interior NV) but the total acres are relatively few. Areas identified with high and very high burn probability are most likely to experience large fires given fire history, fuels, weather and topography. Results are displayed in the table 5 and Figure 10.

Table 5, Percentages of sage-grouse PAC areas with high and very high burn probability, 75% BBD within PAC, 75% BBD and warm dry/temperature regime, and 75% BBD and warm dry/temperature and warm dry/temperature with high and very high burn probability.

Sage Grouse Mangement Zone	*Sage-grouse Priority Area for Conservation (PAC) Name*	*Total PAC Acres*	*High, very high burn probability (percent of PAC acres)*	*75% BBD within PAC (percent PAC acres)*	*75% BBD and warm and dry soil/temperature regime ~~acres~~ (percent PAC acres)*	*75% BBD and warm and dry soil/temperature regime with high, very high burn probability (percent PAC acres)*
4	*Northern Great basin*	*13,045,415*	*86%*	*57%*	*19%*	*17%*
3	*Southern Great Basin*	*9,461,355*	*48%*	*33%*	*20%*	*9%*
4	*Snake, Salmon, and Beaverhead*	*5,477,014*	*68%*	*52%*	*5%*	*4%*
5	*Western Great Basin*	*3,177,253*	*61%*	*66%*	*15%*	*12%*
5	*Warm Springs Valley /Western Great Basin*	*3,520,937*	*30%*	*44%*	*28%*	*9%*
4	*SW Montana*	*1,369,076*	*1%*	*48%*	*0%*	*0%*
4	*Northern Great Basin/Western Great Basin*	*1,065,124*	*82%*	*59%*	*30%*	*22%*
5	*Central Oregon*	*813,699*	*71%*	*56%*	*3%*	*2%*
3	*Panguitch/Bald Hills*	*1,135,785*	*70%*	*31%*	*1%*	*1%*
3	*Parker Mountain-Emery*	*1,122,491*	*28%*	*28%*	*0%*	*0%*
4	*Box Elder*	*1,519,454*	*61%*	*19%*	*4%*	*2%*
4	*Baker Oregon*	*336,540*	*74%*	*55%*	*25%*	*21%*
3	*NW-Interior NV*	*371,557*	*99%*	*29%*	*12%*	*11%*
3	*Carbon*	*355,723*	*22%*	*27%*	*0%*	*0%*
3	*Strawberry*	*323,219*	*26%*	*16%*	*0%*	*0%*
3	*Rich-Morgan-Summit*	*217,033*	*79%*	*17%*	*0%*	*0%*
3	*Hamlin Valley*	*341,270*	*60%*	*1%*	*1%*	*0%*
3	*Ibapah*	*98,574*	*0%*	*0%*	*0%*	*0%*
3	*Sheeprock Mountains*	*611,374*	*98%*	*0%*	*0%*	*0%*
5	*Klamath OR/CA*	*162,667*	*98%*	*0%*	*0%*	*0%*

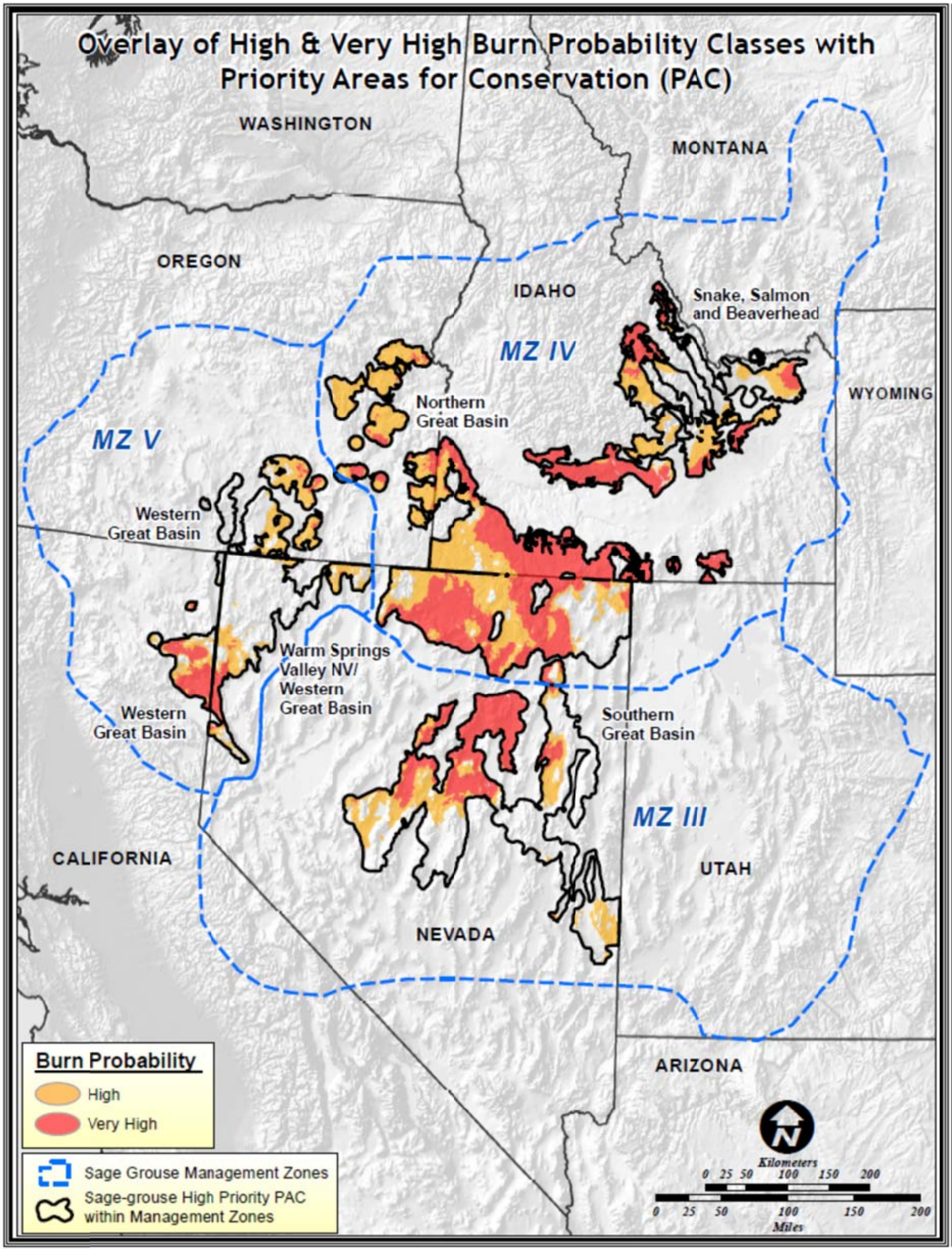

Figure 10, Burn Probability (high and very high) in priority invasive annual grass and wildfire PACs. .

Conifer Expansion. (See priority PACs for assessment identified in Table 4 and focal habitats shown in Figure 9). Focal habitats, as they relate to conifer expansion, are defined as sage-grouse habitat in a priority PAC with sagebrush landscape cover between 25 and 100 percent that is either near or in a conifer expansion area. The relationship between conifer expansion and resilience to disturbance and resistance to expansion is not documented to the same degree as with invasive annual grasses. However, Appendix 5 (D. and E.) in Chambers et al. 2014) includes two generalized state and transition models for conifer expansion with warm to cool and soil temperature regimes associated with precipitation ranges from 12 to 14 or more inches of annual precipitation. These state and transition models are useful in developing management strategies to deal with conifer expansion as they contain useful restoration pathways.

Chambers et al. 2014) is recommended for review at this point for information on applying resistance and resilience concepts along with sage-grouse habitat characteristics to develop management strategies to address wildfires, invasive annual grasses, and conifer expansion. The following tables are recommended for use in developing management strategies in or near focal habitats:

Table 1. Soil temperature and moisture regimes relationship to vegetation types and resistance and resilience.
Table 2. Sage-grouse habitat matrix showing the relationship between landscape sagebrush cover and resistance and resilience.
Table 3. Potential management strategies based on sage-grouse habitat requirements and resistance and resilience.
Table 4. Management strategies (fire suppression, fuels management, post-fire rehabilitation, and habitat restoration) associated with each cell in the sage-grouse habitat matrix (Table 2).

The "Putting it all together" section of the Chambers et al. 2014) also contains a case study from Northeast Nevada illustrating applications of management strategies to address the conservation, protection, and restoration of sage-grouse habitat.

To further assist in understanding Step 1b, examples of general priorities for management strategies are provided below and illustrated in Appendix 3 and 4:

1. Fuels Management: Projects that are designed to change vegetation composition and/or structure to modify potential fire behavior for the purpose of improving fire suppression effectiveness and limiting fire spread and intensity.
    a. Identify priorities and potential measures to reduce the threats to sage-grouse habitat resulting from changes in invasive annual grasses (primary focus on exotic annual grasses and conifer encroachment) and wildland fires. Place high priority on areas dominated by invasive annual grasses that are near or adjacent to low resistance and resilience habitats that are still intact.
    b. Areas on or near perimeter of successful post-fire rehabilitation and habitat restoration projects where threats of subsequent fire are present are important for consideration.

   c. Fuels management can be a high priority in large tracts of intact sagebrush if impacts on sage-grouse populations are minimal and outweighed by the potential benefits of reduced wildfire impacts in area being protected.

2. Habitat Recovery/Restoration Recovery (passive restoration) is a high priority in intact sagebrush stands to improve resistance and resilience before a disturbance. For example, where understory perennial herbaceous species are limited, improved livestock grazing practices can increase the abundance of these species and promote increased resistance to annual grasses.
   a. Habitat restoration is important where habitat connectivity issues are present within focal habitats.
   b. Pinyon pine and/or juniper removal in Phase I and II stands adjacent to large, contiguous areas of sagebrush (greater than 25 percent sagebrush landscape cover) is a priority.

3. Fire Operations (includes preparedness, prevention and suppression activities).
   a. Higher priority should be placed on areas with greater than 65 percent cover than on areas with 25 to 65 percent cover, followed by 0 to 25 percent cover (these categories are continuums not discrete thresholds).
   b. Higher priority should be placed on lower resistance/resilience habitats compared with higher resistance/resilience habitats.
   c. Fire operations in areas restored or post-fire rehabilitation treatment where subsequent wildfires can have detrimental effect on investment and recovery of habitat are important for consideration.
   d. Fire operations (suppression) are especially important in low elevation winter sagebrush habitat with low resistance and resiliency.
4. Post-Fire Rehabilitation
   a. High priority should be placed on supporting short-term natural recovery and long-term persistence in higher resistance and resiliency habitats (with appropriate management applied).
   b. High priority should be placed on reseeding in moderate to low resistance and resiliency habitats, but only if competition from invasive annual grasses, if present, can be controlled prior to seeding.

Step 2

Step 2 is carried out by local management units using the Step 1 geospatial data, focal habitats, and the associated management strategies. Step 2 includes evaluating the availability and accuracy of local information and geospatial data used to develop local management strategies in or near focal habitats (Step 2a).

It also involves developing focal habitat activity/implementation plans that include prioritized management tactics and treatments to implement effective fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation (Step 2b). These activity/implementation plans will serve as the basis for NEPA analysis of site-specific projects.

Step 2a- Review of Step 1 Data and Incorporation of Local Information

Evaluate the accuracy and utility of Step 1 geospatial layers for focal habitats by incorporating more accurate or locally relevant:

- Vegetation maps (especially sagebrush cover)
- Updated or higher resolution conifer expansion layers (if applicable)
- Soil survey and ecological site descriptions
- Weather station, including Remote Automatic Weather Stations, data
- PACs, focal habitats, winter habitats, sage-grouse population distributions (i.e., more recent BBD surveys)
- Maps of cheatgrass and other invasive annual grasses that degrade sage-grouse habitat
- Wildfire polygons including perimeters and unburned islands within burn polygons
- Treatment locations and success (consult US Geological Survey Land Treatment Digital Library at http://ltdl.wr.usgs.gov/). The Land Treatment Digital Library allows the user to search on treatment results on an ecological site basis.
- Models and tools to help inform management strategies. For example, data which characterizes wildfire potential can help identify risk to focal habitats and help plan fire suppression and fuels management strategies to address these risks.
- Rapid Ecoregional Assessments
- Land Use Plans
- Appropriate monitoring or inventory information
- Any other geospatial data or models that could improve the accuracy of the assessment process

It is essential that subregional or local information and geospatial data be subjected to a quality control assessment to ensure that it is appropriate to use in developing Step 2b activity and implementation plans. Since PACs and focal habitats usually transcend multiple administrative boundaries, a collaborative approach is highly recommended for Step 2a.

A series of questions tied to the management strategies described in the Introduction section follows to assist managers in developing the framework to complete Step 2b (development of activity/implementation plans). The questions that follow apply to the focal habitats (and buffer areas around focal areas where management strategies may be more effectively applied) and will help in developing coordinated implementation/activity plans. These questions should not limit the scope of the assessment and additional questions relative to local situations are encouraged. These questions portray the minimum degree of specificity for focal habitats in order for offices to complete Step 2a.

Fuels Management

1. Where are the priority fuels management areas (spatially defined treatment opportunity areas that consider fire risk, fuels conditions, and focal habitats [including areas adjacent to focal habitats])?
2. Based on fire risk to focal habitats, what types of fuels treatments should be implemented to reduce this threat (for example, linear features that can be used as anchors during suppression operations)?
3. Considering resistance/resilience concepts and the landscape context from Step 1, where should treatments be applied in and around focal habitats to:
    a. Constrain fire spread?
    b. Reduce the extent of conifer expansion?
    c. Augment future suppression efforts by creating fuel breaks or anchors for suppression?
4. Based on opportunities for fire to improve/restore focal habitats, what types of fuels treatments should be implemented to compliment managed wildfire by modifying fire behavior and effects?
5. Are there opportunities to utilize a coordinated fuels management approach across jurisdictional boundaries?
6. What fuel reduction techniques will be most effective that are within acceptable impact ranges of local sage-grouse populations, including but not limited to grazing, prescribed fire, chemical, and biological and mechanical treatments? Will combinations of these techniques improve effectiveness (e.g., using livestock to graze fine fuels in a mowed fuel break in sagebrush)?

Habitat Recovery/Restoration

1. Are there opportunities for habitat restoration treatments to protect, enhance or maintain sage-grouse focal habitat especially to restore connectivity of focal area habitat?
2. Considering the resistance and resilience GIS data layer (Figure 4) and the Sage-Grouse Habitat Matrix (Chambers et al. 2014; Table 2), where and why would passive or active restoration treatments be used?
3. What are the risks and opportunities of restoring habitat with low resistance and resilience including the warm/dry and cool/dry soil moisture/temperature regime areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to effectively complete habitat restoration in focal habitats?

Fire Operations

1. Where are priority fire management areas (spatially defined polygons having the highest need for preparedness and suppression action)?

2. Where are the greatest wildfire risks to focal habitats considering trends in fire occurrence and fuel conditions (see Figure 10)?
3. Where do opportunities exist that could enhance or improve suppression capability in and around focal habitats?
    a) For example, increased water availability through installation of helicopter refill wells or water storage tanks.
    b) Decreased response time through pre-positioned resources or staffing remote stations.
4. Should wildfire be managed (per land use plan objectives) for improving focal habitat (e.g., reducing conifer expansion), and if so where, and under what conditions?
5. How can fire management be coordinated across jurisdictional boundaries to reduce risk or to improve focal habitats?

Post-fire Rehabilitation

1. Where are areas that are a high priority for post-fire rehabilitation to improve habitat connectivity if a wildfire occurs?
2. Which areas are more conducive (higher resistance and/or resilience) to recovery and may not need reseeding after a wildfire?
3. What opportunities to build in fire resistant fuel breaks to reduce the likelihood of future wildfires impacts on seeded or recovering areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to implement rehabilitation practices?

The outcome of Step 2a is the assembly of the pertinent information and GIS layers to assist managers in developing implementation or activity plans to address wildfires, invasive annual grasses, and conifer expansion in focal habitats. Activity plans generally refer to plans where management of a resource is changed (livestock grazing plans) whereas implementation plans are generally associated with treatments.

Step 2b- Preparation of Activity/Implementation Plans

Activity/implementation plans are prepared to implement the appropriate management strategies within and adjacent to focal habitats. Since focal habitats cross jurisdictional boundaries, it is especially important that a collaborative approach be used to develop implementation/activity plans. The process of identifying partners and creating collaborative teams to develop these plans is a function of state, regional, and local managers and is not addressed as part of this step.

Implementation/activity plans are required to:

1. Address issues in and around focal habitats related to wildfires, invasive annual grasses, and conifer expansion

2. Use resistance to invasive annual grasses and resilience after disturbance (where appropriate) as part of the selection process for implementing management strategies
3. Emphasize application of management strategies within or near focal habitats with low resistance and resilience (warm/dry and cool/dry soil moisture/temperature regimes) invasive annual grasses and wildfires
4. Use the best available local information to inform the assessment process
5. Encourage collaboration and coordination with focal habitats across jurisdictional boundaries
6. Be adaptive to changing conditions, disturbances, and modifications of PAC boundaries

FIAT recommends considering other factors, such as adaptive management for climate change, local sagebrush mortality due to aroga moth or other pests, and cheatgrass die-off areas in developing activity/implementation plans. The latter two factors could influence where and what kind of management strategies may be needed to address the loss of habitat or changes in fuel characteristics (e.g., load and flammability) associated with these mortality events.

The following recommendations are provided to assist in the preparation of activity/implementation plans:

Fuels Management

1. Spatially delineate priority areas for fuel management treatments per Step 2a information considering:
    a. Linear fuel breaks along roads
    b. Other linear fuel breaks to create anchor points
    c. Prescribed burning which would meet objectives identified in the Fish and Wildlife Service's Conservation Objectives Team (COT) report
    d. Mechanical (e.g., treatment of conifer expansion into sagebrush communities)
    e. Other mechanical, biological, or chemical treatments
    f. If they exist, spatially delineated areas where fuel treatments would increase the ability to use fire to improve/enhance focal habitats.
2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of fuels treatments.
3. Quantify a projected level of treatment within or near focal habitats.
    a. Identify treatments (projects) to be planned within or near focal habitats.
    b. Include a priority and proposed work plan for proposed treatments.

Habitat Recovery/Restoration

1. Spatially delineate priority areas for restoration, using criteria established in Step 2a. Priority areas for restoration should be delineated by treatment methods:
    a. Seeding priority areas
    b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological, combination)

    c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding).
    d. Include tables, maps or appropriate info.
2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of restoration treatments.
3. Include a priority or implementation schedule for proposed restoration treatment

Fire Operations

1. Spatially delineate priority areas for fire suppression, based upon criteria established in Step 2a. Priority areas for fire operations should be delineated by type, such as:
    a. Initial attack priority areas
    b. Resource pre-positioning and staging priority areas
2. Spatially delineate areas where opportunities exist to enhance or improve suppression capability.
3. Spatially delineate areas where wildfire can be managed to achieve land use plan and COT objectives.

Post-Fire Rehabilitation

1. Spatially delineate priority areas for post-fire rehabilitation using criteria in Step 2a.
2. Priority areas for post-fire rehabilitation should be based on resistance and resiliency and pre-fire landscape sagebrush cover and include consideration of:
    a. Seeding priority areas
    b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological (herbivory or seeding),
    c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding)
3. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of post-fire rehabilitation treatments.

This completes the assessment process and sets the stage for more detailed project planning and NEPA associated with implementing on-the-ground treatments and management changes.

Members of the FIAT Development and Review teams are listed in Appendix 5.

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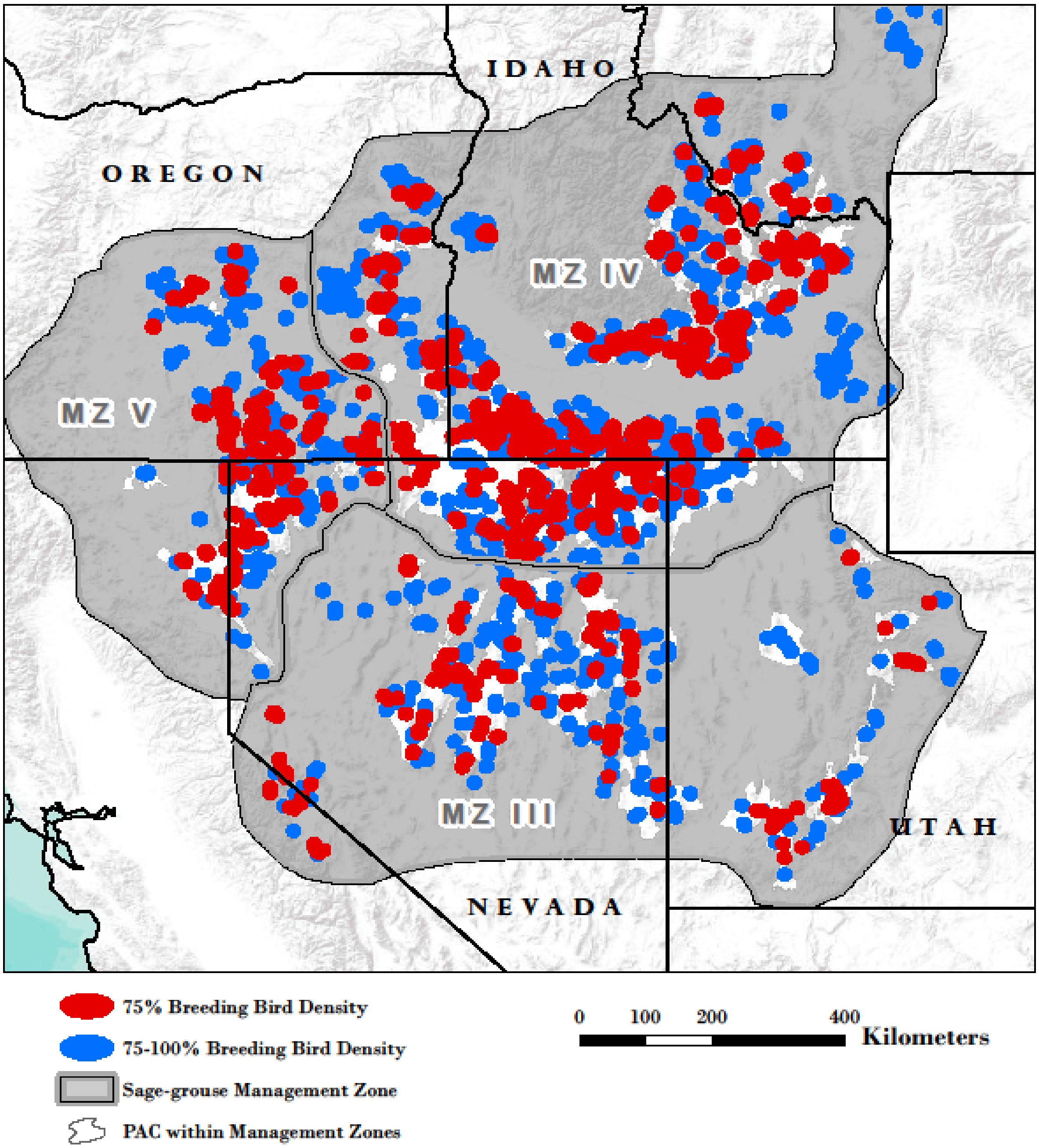
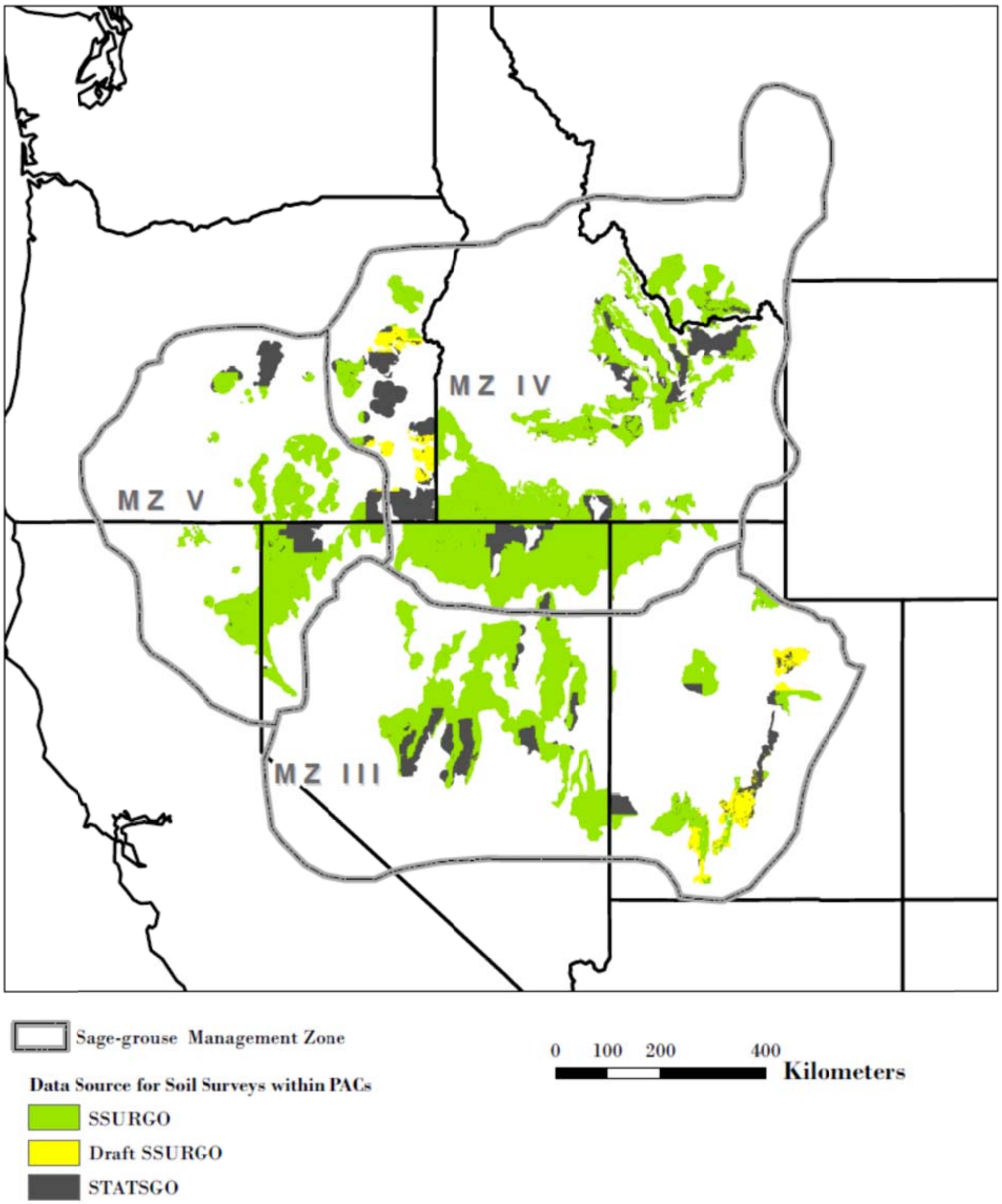
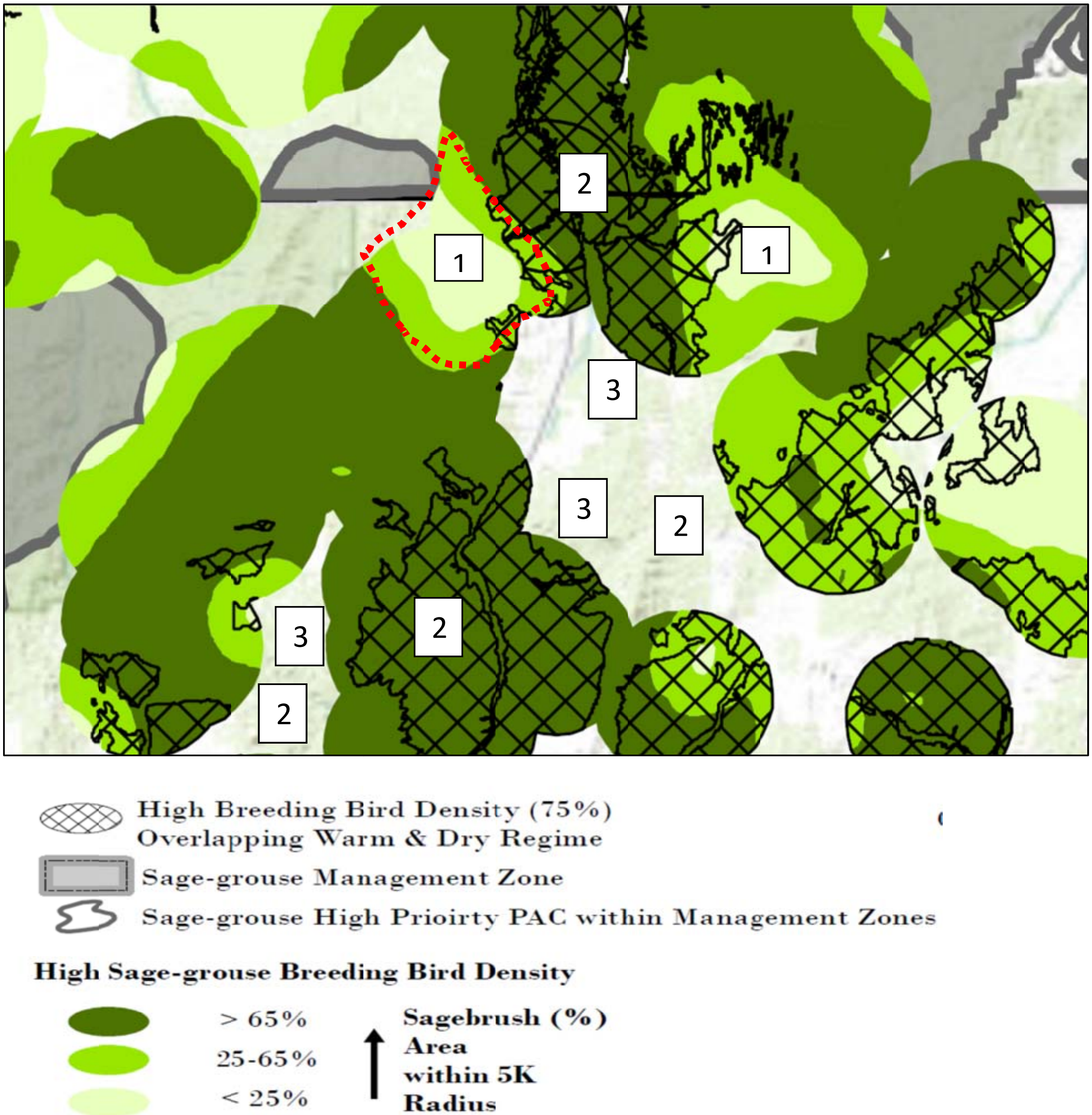
Appendix 1. Sage-grouse breeding bird density thresholds for 75% and 100% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is included in this figure to provide context for local management units when making decisions concerning connectivity between populations and PACs.



Appendix 2. Gaps in SSURGO soil survey data in Management Zones III, IV, and V. STATSGO2 soil survey data used to fill these gaps.



Appendix 3. Example of potential management strategies applied to Wildfire/Invasive Annual Grass Scenario.

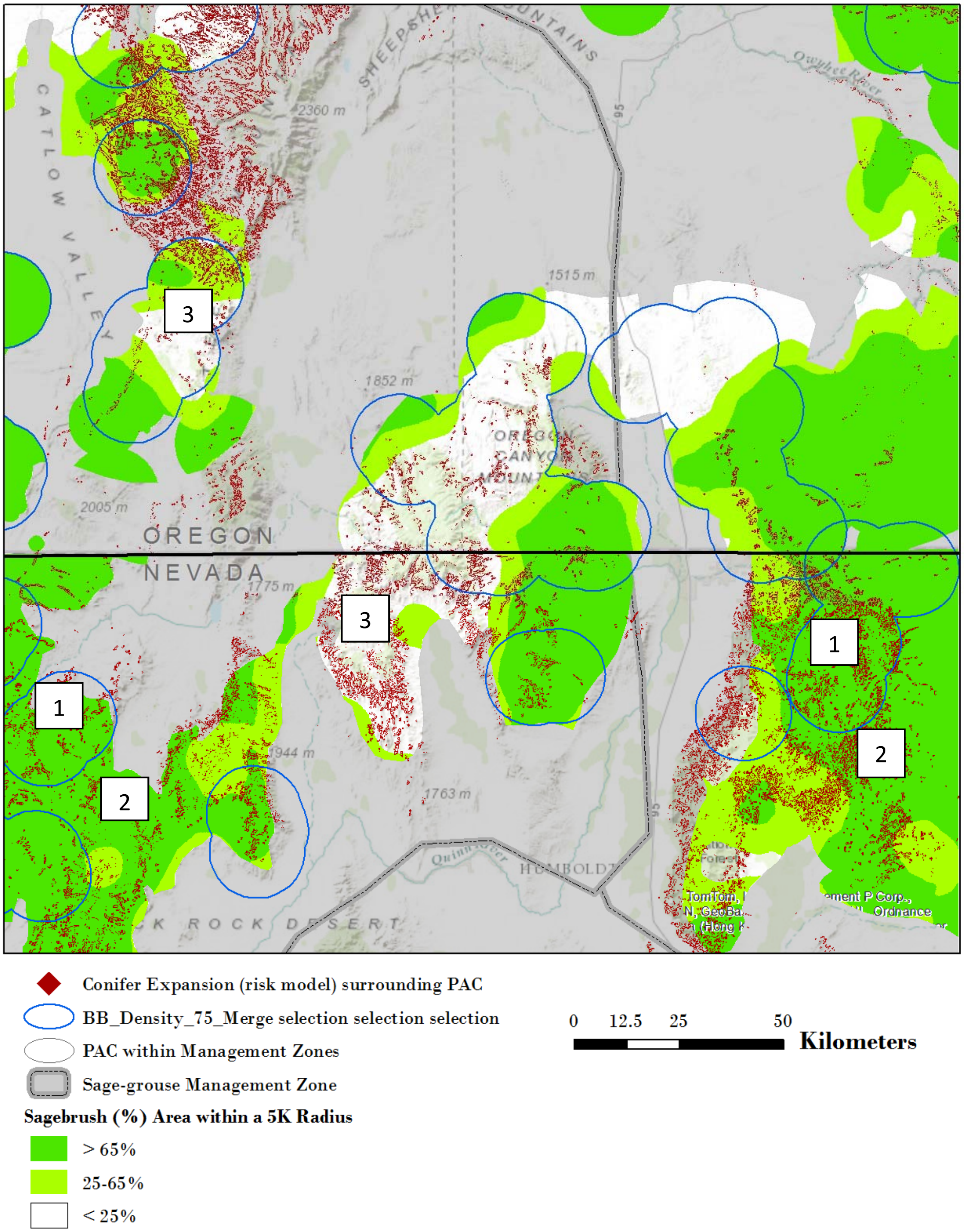


1 High priority for habitat restoration and post-fire rehabilitation to restore connectivity.

2 High priority for fire suppression within and around area given >65% sagebrush landscape cover and low resistance/resilience.

3 **High priority for fuels management to reduce likelihood of wildfires in low resistance/resilience habitat** with >65% landscape cover.

Appendix 4. Management strategy example for Western Juniper expansion.



1	High priority (emphasis area) for juniper control (>25% landscape sagebrush cover & 75% BBD)
2	Moderate priority (emphasis area) for juniper control (>25% landscape sagebrush cover)
3	Very low priority (<25% landscape sagebrush cover)

Appendix 5. Members of FIAT Development and Review Team

Development Team

Name	Affiliation
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Appendix J

Avoid, Minimize, and Apply Compensatory Mitigation Flowchart

APPENDIX J
AVOID, MINIMIZE, AND APPLY COMPENSATORY MITIGATION FLOWCHART

INTRODUCTION

The Net Conservation Gain strategy is a means of assuring that proposed anthropogenic activities, when approved and implemented, will not result in long-term degradation of GRSG habitat or population. In order to ensure that management activities have a net conservation gain to the species, a proposal may be redesigned, mitigated, deferred, or denied. The attached flow chart identifies a suggested process for review of proposed anthropogenic activities and is not a land use plan requirement. The goal of the process is to provide a consistent approach regardless of the administrative location of the project and to ensure that authorization of these projects will not contribute to the decline of the species. The flow chart provides for a sequential screening of proposals. Steps 1through 6 are related to project planning, and the subsequent steps are related to project implementation.

Step 1

This review process is initiated upon formal submittal of a proposal for authorization for use of federal lands (BLM or Forest Service). The actual documentation of the proposal would include, at a minimum, a description of the location, scale of the project, and timing of the disturbance. It is anticipated that the proposals would be submitted by a third party. The acceptance of the proposal(s) would be consistent with existing protocol and procedures for each type of use.

Step 2

In reviewing a proposal, determine if the project will have a direct and indirect impact on population or to the habitat (PHMA or GHMA). This can be done by:

1. Coordination with the appropriate State agencies such as Sagebrush Ecosystem Technical Team or Nevada Department of Wildlife
2. Reviewing Greater Sage-Grouse Habitat maps
3. Reviewing the 'Base Line Environment Report' (USGS), which identifies the area of direct and indirect effect for various anthropogenic activities
4. Consultation with agency or State Wildlife Agency biologist
5. Other methods

If the proposal will not have a direct or indirect impact on either the habitat or population, proceed with the appropriate process for review, decision, and implementation of the project.

Step 3

This initial review should evaluate whether the proposal would be allowed as prescribed in the Greater Sage-Grouse Land Use Plan Amendment (LUP). For example, certain activities are prohibited in PHMA habitat, such as new mineral material sites. If the proposal is an activity that is specifically prohibited, the applicant should be informed that the application is being rejected since it would not be allowed, regardless of the design of the project.

In addition to being consistent with program allocations, the LUP identifies a limit on the amount of disturbance that is allowed within a 'biological significant unit' (BSU). If current disturbance within the affected BSU exceeds this threshold, the project would be reviewed to determine if new or site-specific information indicates the project could be modified to result in a net conservation gain at the BSU level. Factors considered will include GRSG abundance and trends, habitat amount and quality, extent of project disturbance, location and density of existing disturbance, project design options, and other biological factors.

Step 4

If the project may be authorized in accordance with the GRSG Land Use Plan Amendment, review the proposal in regards to Land Use Plan Amendment Objective SSS 4. The first approach is to determine if the proposal can be located in non-habitat, or if not, marginal habitat. If the proposal cannot be relocated to avoid impacts on GRSG, apply the screening criteria identified in the Land Use Plan Amendment Management Actions SSS-2 thru SSS-4. This review should be coordinated with the appropriate State agencies such as Sagebrush Ecosystem Technical Team or Nevada Department of Wildlife.

Step 5

If the preliminary review of the proposal (Step 4) concludes that there may be impacts on GRSG habitat and the project cannot be designed to result in a net conservation gain to GRSG, evaluate whether the agency has the authority to modified or deny the project. If the agency does NOT have the discretionary authority to modify or deny the proposal, proceed with the authorization process (NEPA) (Step 7-12) and include appropriate mitigation requirements, subject to valid existing rights, such as those identified through the Nevada Conservation Credit System, that minimize impacts on GRSG habitat and populations.

Step 6

If the agency has the discretionary authority to deny the project and after careful screening of the proposal (Steps 1-4) has determined that direct and indirect effects would not result in a net conservation gain to GRSG, evaluate the proposal to determine if compensatory mitigation such as the Nevada Conservation Credit System would result in a 'net conservation gain' to GRSG.

If the impacts cannot be effectively mitigated within the BSU, reject or defer the proposal. The criteria for determining this situation could include but are not limited to:

- Natural disturbance within the BSU is significant, and additional activities within the area would adversely impact the species.
- The current trend within the BSU is down, and additional impacts, whether mitigated or not, could lead to further decline of the species or habitat.
- The proposed mitigation has proven to be ineffective or is unproven in terms of science-based approach.
- The project would impact habitat that has been determined, through monitoring, to be a limiting factor for species sustainability within the BSU.
- Other site-specific criteria that determined the project would lead to a downward change in the current species population or habitat with the BSU.

Step 7-12

If the project can be mitigated to provide for a net conservation gain to the species, proceed with the design of the mitigation plan and authorization (NEPA) of the project, and monitoring. If an offsite mitigation plan is deemed appropriate, consider a program such as the Nevada Conservation Credit System.

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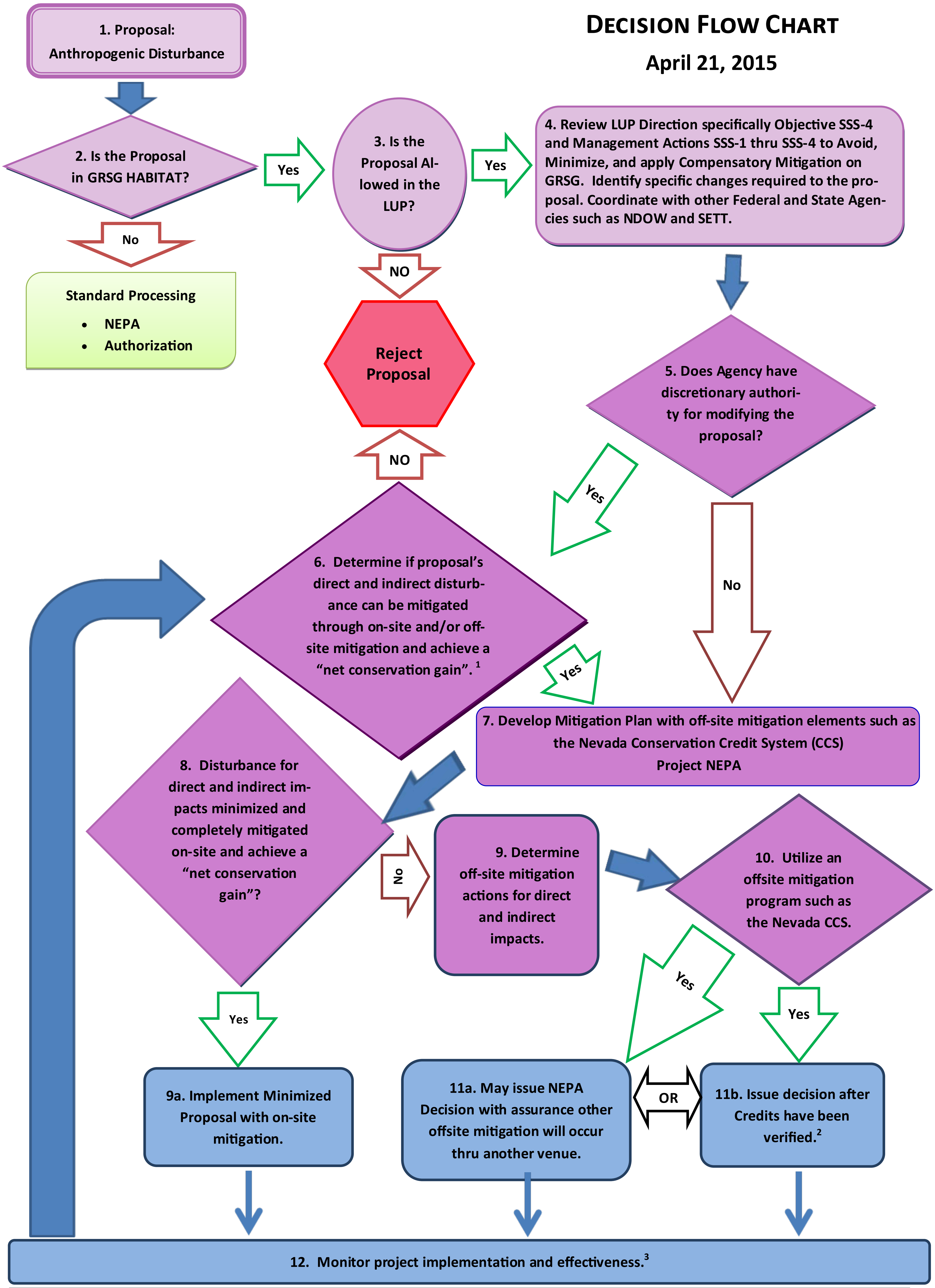
DECISION FLOW CHART

April 21, 2015



[1] In determining if the proposal disturbance can be mitigated through processes such as the Nevada Conservation Credit System, the result of the mitigation action has
to produce a net conservation gain for GRSG.

[2] Off-site mitigation projects mitigate by:

- Protective actions for future natural disturbance (i.e., fuel breaks, green strips) and/or restoration of legacy natural or anthropogenic Disturbances

[3] All monitoring is done in accordance with established protocols and incorporated into future Mitigation Plans. Results will feed back into the determination on whether future proposals can be mitigated in Step 6.

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Appendix K
Greater Sage-Grouse Noise Protocol

APPENDIX K
GREATER SAGE-GROUSE NOISE PROTOCOL

The following recommendations are intended to serve as a general protocol for collection of noise measurements in areas of existing and proposed development. The intent is to provide guidelines to experienced personnel so that measurements are made in a consistent and accurate manner and to highlight areas where specialized training and equipment is required. The goal is to develop a protocol that is efficient, effective, and produces consistent results. The protocol was written to facilitate the gathering of noise measurements relevant to stipulations for GRSG protection. Use of a standard protocol for noise monitoring will ensure that future measurements are comparable across locations, times, and surveyors. This protocol should be considered a work in progress and should be updated, in coordination with appropriate entities as data needs and availability change (Blickley and Patricelli 2013).

SUMMARY OF NOISE-MONITORING RECOMMENDATIONS

- Measurements should be made by qualified personnel experienced in acoustical monitoring.
- Measurements should be made with a high quality, calibrated Type I (noise floor < 25 dB) sound level meter (SLM) with a microphone windscreen and (where applicable) environmental housing.
- Measurements should be collected during times when noise exposure is most likely to affect greater sage-grouse— nights and mornings (i.e. 6 pm – 9 am) and should be taken for ≥1 hour at each site, ideally over multiple days with suitable climactic conditions. To capture typical variability in noise level at the site of interest, deployment of SLM units for multiple days is preferred.
- Environmental conditions should be measured throughout noise measurement periods so that measurements made during unsuitable conditions can be excluded.

- Measurements should be made at multiple (3-4) locations between each noise source and the edge of the protected area. On-lek measurements should exclude time periods when birds are lekking.
- Accurate location data should be collected for each measurement location. Surveyors also should catalog the type and location of all nearby sources of anthropogenic noise.
- Critical metrics should be collected: L50, L90, L10, Leq, and Lmax. All measurements should be collected in A-weighted decibels (dBA) and, if possible, also collected in unweighted (dBF) and C-weighted (dBC) decibels. If possible, SLM should log 1/3-octave band levels throughout the measurement period. Additional metrics may be collected, depending on the goals of the study.
- Due to the difficulty of measuring ambient noise levels in quiet conditions, we recommend the use of both empirical sampling and ambient noise modeling to establish baseline ambient values.

References

See the following studies for complete protocols and methods:

Blickley, J. L, and G. L. Patricelli. 2013. Noise monitoring recommendations for Greater Sage-Grouse habitat in Wyoming. Prepared for the PAPA, Pinedale, WY.

Ambrose, S., and C. Florian. 2013. Sound Levels of Gas Field Activities at Greater Sage-Grouse Leks, Pinedale Anticline Project Area, Wyoming. Prepared for Wyoming Game and Fish Department Cheyenne, WY.

Appendix L
State of Nevada Conservation Credit System

APPENDIX L
STATE OF NEVADA CONSERVATION CREDIT SYSTEM

The following information was provided by the State of Nevada and incorporated in the State of Nevada's Greater Sage Grouse Conservation Plan (2014; **Alternative E**). The conservation credit system is one form of mitigation that the BLM and Forest Service would consider using in the Proposed Plan.

EXECUTIVE SUMMARY

The Conservation Credit System (Credit System) is a pro-active solution that provides net conservation benefits for the greater sage-grouse, while balancing the need for continued human activities vital to the Nevada economy and way of life. The Credit System creates new incentives for private landowners and public land managers to preserve, enhance, restore, and reduce impacts to important habitat for the species.

The Credit System is a market-based mechanism that quantifies conservation outcomes (credits) and impacts from anthropogenic disturbances (debits), defines standards for market transactions, and reports the overall progress from implementation of conservation actions throughout the greater sage-grouse range within Nevada. The Credit System establishes the policy, operations and tools necessary to facilitate effective and efficient conservation investments. The Credit System is intended to provide regulatory certainty for industries by addressing compensatory mitigation needs whether or not the species is listed under the Endangered Species Act.

GOAL & SCOPE

The goal of the Credit System is to achieve no net unmitigated loss of greater sage-grouse habitat due to anthropogenic disturbances with the Sage-Grouse Management Area (SGMA; **Figure 1.1**), in order to stop the decline of greater sage-grouse populations. All proposed anthropogenic disturbances, as defined in the 2014 Nevada Greater Sage-Grouse Conservation Plan, must seek to avoid, minimize, and mitigate impacts to greater sage-grouse habitat. After all possibilities to avoid and minimize impacts to greater sage-grouse habitat have been exhausted, mitigation of residual adverse impacts on greater sage-grouse habitat are required to be offset by mitigation requirements as determined through the Credit System.

Figure 1.1: Sage-Grouse Management Area Map, 2014.

The Credit System applies to the 2014 SGMA. Anthropogenic disturbances to habitat on Bureau of Land Management (BLM) and Forest Service (USFS) lands within the SGMA require consultation with the Sagebrush Ecosystem Technical Team (SETT) and the appropriate federal land management agency. Private landowners are not required to mitigate anthropogenic disturbances on their land, but are welcome to voluntarily generate, sell, or purchase credits in the Credit System. The Credit System scope can be expanded in the future to support additional conservation needs, revisions to habitat and management maps, or to include other states within the greater sage-grouse range.

Guiding Principles

The Credit System enables the preservation, enhancement, and restoration of a resilient and resistant sagebrush ecosystem in a credible, rigorous and cost-effective way. The Credit System abides by the following guiding principles:

- Produce high quality conservation where it makes significant ecological difference.
- Enable decision-making based on the best available science.
- Create an efficient marketplace, where every transaction is anticipated to result in a net benefit for the greater sage-grouse.
- Foster transparency, accountability, and credibility.
- Improve the effectiveness and efficiency of the Credit System over time.

Roles

The Nevada Division of State Lands, within the Nevada Department of Conservation and Natural Resources, holds ultimate authority over Credit System design, operations, and management. The Sagebrush Ecosystem Council oversees Credit System operations and approves changes to the program. The Administrator manages the Credit System's day-to-day operations and ongoing program improvements, facilitates transactions, and reports programmatic results. Credit System operations are also informed by Resource Managers (e.g., BLM, NDOW, USFS, USFWS) and by a Science Committee to ensure the

System functions according to current law, policy, and regulations and is consistent with the best available science.

Credit Developers are landowners, land managers, organizations, or agencies, that produce, register, or sell credits in the Credit System. Buyers are entities that purchase mitigation credits for anthropogenic disturbances or to meet other conservation objectives.

Operational Overview & Management System

The steps for generating and transacting credits are depicted in **Figure 1.2**, below. Blue chevrons signify the steps undertaken to generate credits, green chevrons represent the exchange of credits. More detailed information on each of these steps can be found in the Nevada Conservation Credit System Manual[1].

Figure 1.2: Overview of the Process Steps to Generate and Purchase Credits

Credit System Currency

Credits are the currency of the Credit System. A credit represents a verified "functional acre" that meets the durability criteria defined by the Credit System, such as committing to a Customized Management Plan that maintains habitat performance and limits risks from future impact for the duration of the project. A functional acre is based on habitat quality ("function") relative to optimal conditions, and quantity (acres). This is determined through the Habitat Quantification Tool (HQT; see the HQT Overview).

Generating Credits

The following steps outline the process to generate, verify and register credits from a conservation project (including habitat preservation, enhancement and restoration projects).

1. **Select & Validate Site:** Validation indicates to Credit Developers that they are eligible to generate credits on their project site, based on eligibility criteria, and provides some technical commentary on project design. This stage provides a screen to minimize investment and expenditures on the part of participants that may not be eligible to generate credits.
2. **Implement & Calculate Credit:** Credit Developers design the project, quantify the expected number of credits using the HQT, implement conservation practices, and refine calculations based on on-the-ground conditions.

[1] The Nevada Conservation Credit System Manual can be found on the Sagebrush Ecosystem Program's Website: http://sagebrusheco.nv.gov/

3. **Verify Conditions:** All projects undergo third-party verification to confirm that protocols were followed correctly and projected credits are appropriately calculated and match actual on-the-ground conditions.
4. **Register & Issue:** Once a project has been verified, supporting documentation is submitted to the Administrator where it is reviewed for completeness before credits are registered and issued to the Credit Developer's account on the registry. Upon issuance, credits are given a unique serial number so they can be tracked over time.
5. **Track & Transfer:** Issued credits are tracked by the Administrator using unique serial numbers and a registry, and are either transferred to Buyers or retired. Credit Developers annually confirm that performance standards are met and trigger phased credit releases, where applicable.

Acquiring Credits

The following steps outline the process to purchase credits.

1. **Indicate Initial Interest:** Buyers become aware of the opportunity or requirement to participate in the Credit System, and contact the Administrator to provide basic information. Additional assistance and technical support is available, if desired.
2. **Determine Credit Need:** Buyers determine the duration and amount of credit needed to best meet their needs. If fulfilling a regulatory offset, Buyers determine credit amount needed by determining baseline and post-project conditions of the debit site in accordance with the relevant regulatory instrument and the HQT.
3. **Acquire Credits:** Buyers contact the Administrator and come to terms on credit quantities, price, and timing of funding and other terms. The price, terms and conditions are all set and agreed upon by the Administrator and Buyer – with the only exception being the verification requirements. The Administrator provides notice when credits have been transferred between accounts.
4. **Track & Transfer:** Credits are tracked using unique serial numbers that identify the source of each credit, the HQT version used to estimate credits, and the current owner. Once credits are transferred, Buyers can use that information for internal and external reporting.

Managing the Credit System

The Administrator manages the Credit System under a transparent and inclusive process that is designed to improve the efficiency and effectiveness of the

Credit System over time. This management process is depicted in **Figure 1.3**, and each step is described in detail below.

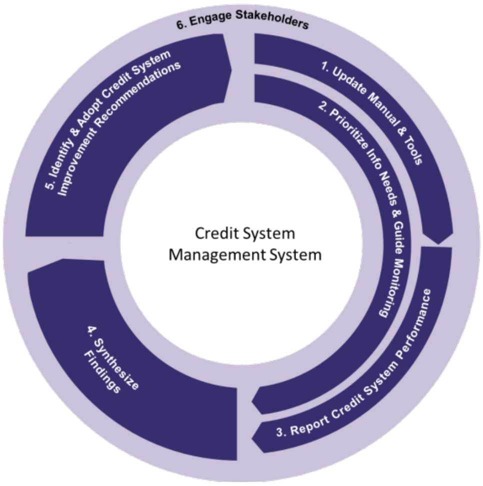


Figure 1.3: Overview of Credit System Management System

1. **Update Manual & Tools:** The Administrator updates the Credit System Manual, tools, forms, and guidance to incorporate practical experience and new scientific information.
2. **Prioritize Information Needs & Guide Monitoring:** The Administrator identifies and prioritizes research and monitoring needs, coordinates funding efforts, and oversees monitoring and research.
3. **Report Credit System Performance:** The Administrator develops the Annual Performance Report to summarize debits, credits and habitat improvements.
4. **Synthesize Findings:** The Administrator synthesizes relevant research, monitoring and operational findings to inform Credit System improvements.
5. **Identify & Adopt Credit System Improvement Recommendations:** The Administrator develops operational and technical improvement recommendations which are reviewed and adopted by the Oversight Committee to ensure the Credit System continues to motivate effective actions over time.
6. **Engage Stakeholders:** Throughout the year, the Administrator engages stakeholders to keep them informed of progress and solicit input for how to improve the Credit System.

POLICY & TECHNICAL CONSIDERATIONS

The Manual contains descriptions of the policy and technical considerations that arise during the generation and sale of credits, determination of debits, and the overall management of Credit System. The table below provides a summary of how the Credit System addresses each of these considerations. The Documentation of Rationale (currently under development), which will be available on the Sagebrush Ecosystem Program's website, will provide additional detail on each consideration, including the rationale behind the current direction.

Table 1
Credit System Considerations Summary

Considerations		Credit System Design Direction/ Options
		Participants
1.	Administrator Responsibilities	• The Administrator facilitates day-to-day operations, participant engagement, and program reporting and improvement
2.	Credit Investment Strategies	• Flexible, but may include: direct credit purchase, reverse auctions, requests for proposals, and selection from list of credit development opportunities

Table 1
Credit System Considerations Summary

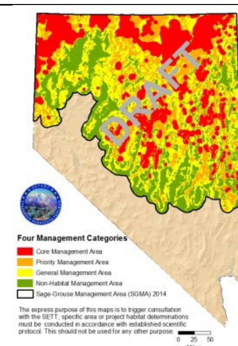
Considerations	Credit System Design Direction/ Options
3. Participant Confidentiality	• As a State-run program certain information must be disclosed upon request by a member of the public; however Credit System published information protects participant confidentiality by aggregating information and removing identification information
	Calculating Credits and Debits
4. Accounting Period	• Annual evidence of performance on credit sites • Annual Credit System management process • Annual programmatic audits
5. Credit Project Types	• **Habitat Preservation:** Maintenance or retention of existing habitat currently used by or in close proximity to habitat used by greater sage-grouse • **Habitat Enhancement:** Manipulation of existing habitat to improve specific habitat functionality • **Habitat Restoration:** The reestablishment of ecologically important habitat or other resource characteristics and function(s) at a site where they have ceased to exist, or where they exist in a substantially degraded state, that renders a positive biological response for the species
6. Service Areas	• All credits and debits must be located within the 2014 SGMA (see **Figure 1.1**)
7. Habitat Quantification Tool Relationship to Credits and Debits	• HQT estimates habitat quality in terms of % function and functional acres • HQT generates habitat quality score for each seasonal habitat type • HQT can estimate pre-project and projected post-project habitat quality • Credits or debits are determined by applying the appropriate mitigation ratio to the functional acres above or below baseline
8. Mitigation Ratios	• Credit and debit ratios are determined by the: – **Habitat Importance Factor:** This is based on the Sagebrush Ecosystem Program's Management Categories Map depicted in Figure 1.4. The value is influenced by the location of a credit or debit site in Core, Priority, or General Management Areas. – **Seasonal Habitat Scarcity Factor:** This is determined by the portion of seasonal habitat type (nesting, late-brood rearing, and winter) impacted by a debit or increased by a credit.  **Figure 1.4: Management Categories Map** • Debits are adjusted by the proximity to potential credit sites (**Proximity Factor**) to determine credit obligation that must be purchased to offset a debit project. This incentivizes mitigation in close proximity to debit sites. The Proximity Factor value increases as follows:

Table 1
Credit System Considerations Summary

Considerations	Credit System Design Direction/ Options
	– The debit and credit sites are within the same Population Management Unit (PMU), depicted in Figure 1.5 (the impacts and benefits are located within a single population); – The debit and credit sites are located within the same WAFWA management zone, depicted in Figure 1.6 (the credit and debit sites are connected through population dispersal); – The credit and debit sites are located within different WAFWA management zones (there is no population connection).

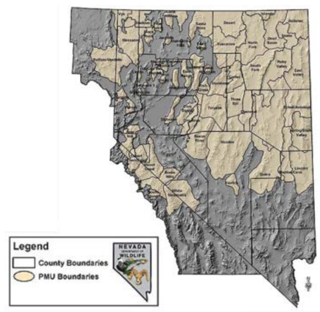


Figure 1.5: NDOW's PMU Map

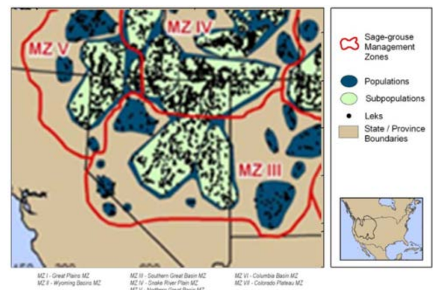


Figure 1.6 WAFWA Management Zones

Considerations	Credit System Design Direction/ Options
9. Baseline	• **Credit baseline:** State-wide standard for each seasonal habitat type equivalent to the average habitat functionality • **Debit baseline:** Pre-project habitat function for each seasonal habitat type
10. Credit Site Eligibility	• Site must be located in the Service Area • Must attest to ownership or use rights, and past stewardship • Post-project habitat functionality must meet 50% minimum functionality • No evidence of an imminent threat of direct or indirect disturbance • Necessary performance assurances must be complete • Credit Developer must attest to the accuracy of the information
11. Credit Release	• **Preservation Projects:** Single habitat performance criteria triggers credit release • **Enhancement Projects:** Habitat performance criteria triggers multiple credit release • **Restoration Projects:** Combination of management actions and habitat performance criteria triggers multiple credit release
12. Project Life	• **Credit Projects:** Minimum 10 year with 5 year increments afterwards, up to perpetual • **Debit Projects:** Until verification that impacts have been restored, up to perpetual
13. Credit variability	• Tolerance threshold of 10% below overall habitat function
Ensuring Performance-Based Results and Net Benefit	
14. Verification	• **Credit Sites**: Before initial credit issuance, before increased credit releases, every 5th year, and periodic spot checks • **Debit Sites**: Before construction, at time when debits are reduced or end, and periodic spot checks

Table 1
Credit System Considerations Summary

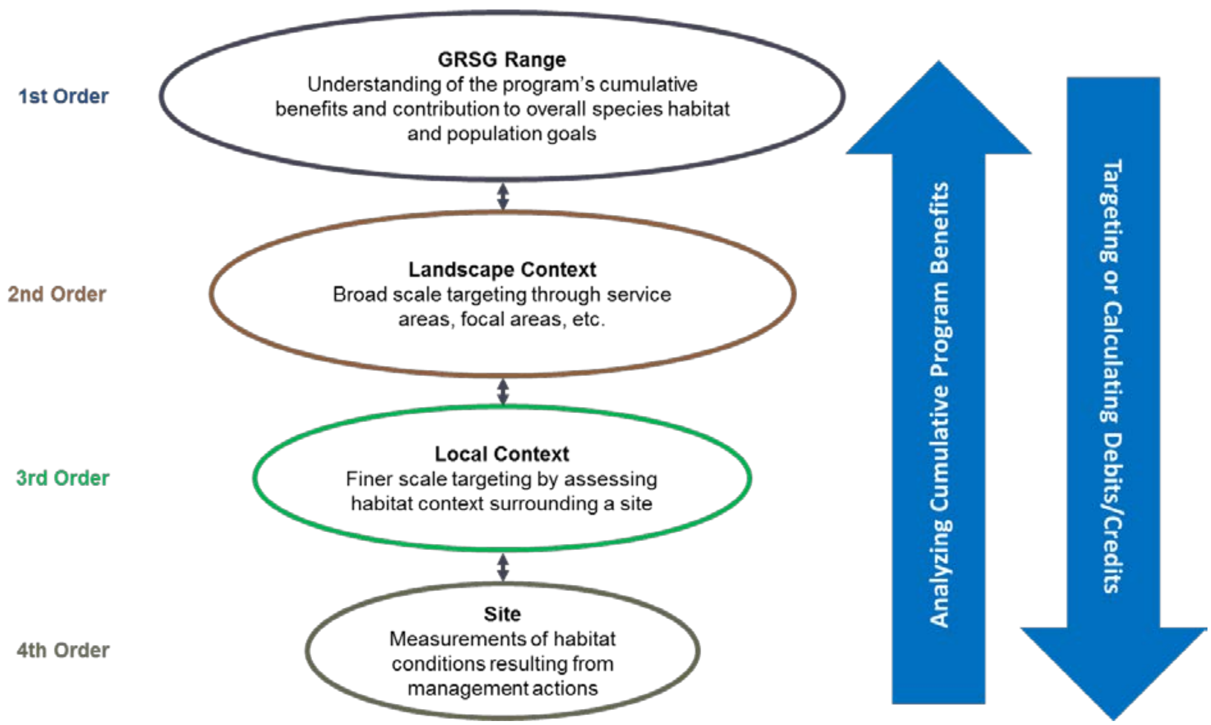
Considerations		Credit System Design Direction/ Options
15.	Stacking of Multiple Credits & Payments	• Credit sites that are enrolled in public conservation programs or have existing land protections, such as conservation easements, are eligible to generate credits for work done above and beyond what is contracted in those existing programs or protections. Stacking allows a Credit Developer to receive multiple payments from the same area of land, but only receive credit for the additional conservation benefits.
16.	Reserve account	• Deposit amount determined by base contribution, probability of wildfire, and probability of competing land uses
17.	Performance Assurances	• Financial instrument contains sufficient funds for management of credit project and to remediate or replace invalidated credits throughout project life • Contract payment is designed to maximize payment to Credit Developer while creating ongoing incentive to achieve credit site performance • **Force Majeure Reversal:** Draw from the reserve account at no cost for a limited duration and Credit Developer provided option to remediate • **Competing Land Use Reversal:** Draw from the reserve account at no cost for a limited duration, and redirect Credit Developer payments to replace invalidated credits • **Intentional Reversal:** Credit Developer payments immediately cease, and payments redirected and other assurances used to replace invalidated credits
		Regulatory Assurance and Policy Integration
18.	Public Lands	• **Durability:** The durability of projects on public lands is safeguarded using land protection mechanisms (e.g. right-of-ways), financial instruments (e.g. contract performance bonds), and the Reserve Account. • **Additionality:** Projects that generate credits must be additional to activities that would occur in the absence of the Credit System. On public lands, credits are additional if the government is not already performing or planning to perform conservation practices using public funds based on an existing mandate.
19.	Application to State and Federal Policies and Regulatory Assurances	• Disturbances within the Sage Grouse Management Area on BLM and USFS lands are expected to be able to calculate debits and purchase credits to mitigate impacts • The future State Plan is expected to direct compensatory mitigation to use the Credit System • A Credit System agreement between the Administrator and the U.S. Fish & Wildlife Service is expected to authorize the use of Credits for mitigation purposes in pre- and post-listing environments

Habitat Quantification Tool Overview

The Credit System's Habitat Quantification Tool (HQT)[2] is the method for quantifying debits and credits. The HQT uses a set of metrics, applied at multiple spatial scales, to evaluate vegetation and environmental conditions related to greater sage-grouse habitat quality and quantity. The HQT enables the Credit System to create incentives to generate credits on the most beneficial locations for the greater sage-grouse, and to minimize impacts to existing high quality habitat.

The HQT is used to calculate scores for each type of seasonal habitat, including nesting habitat (mating, nesting, and early brood-rearing areas), late brood-rearing habitat, and winter habitat. Habitat condition is expressed in "functional acres", which are units of habitat quality ("function") and quantity ("acres") relative to optimal conditions.

The HQT metrics are applied at four spatial scales derived from the Habitat Assessment Framework[3], as illustrated in the diagram below.



[2] The HQT Scientific Methods Document can be found at the Sagebrush Ecosystem Program's Website: http://sagebrusheco.nv.gov/

[3] Stiver, S.J., E.T Rinkes, and D.E. Naugle. 2010. Sage-grouse Habitat Assessment Framework. U.S. Bureau of Land Management. Unpublished Report. U.S. Bureau of Land Management, Idaho State Office, Boise, Idaho.

To quantify the quality of greater sage-grouse habitat, pre-project conditions are measured at the site to determine current ecological performance, or the functional acre score. The debit/credit score is adjusted to account for indirect effects of the local area surrounding the site. Mitigation ratios are applied at the 2nd order scale to ensure that the functional acres of credit acquired are greater than the functional acres of debit. Actual conditions are verified using the HQT, and credits are released according to the habitat quality achieved.

Appendix M
VDDT Methodology

APPENDIX M
VDDT METHODOLOGY

GREATER SAGE-GROUSE HABITAT CHARACTERIZATION FOR USE IN NON-SPATIAL VEGETATION MODELING ACROSS THE GREAT BASIN

Don Major[1], Rob Mickelsen[2], Craig Morris[3]

Introduction

Numerous factors influence sagebrush dynamics in the Great Basin. Each year acres of sagebrush increase in density, or are burned, grazed, converted to invasive annual grass, damaged by insects and disease, encroached by conifers, or altered by various management treatments. Due to the importance of sagebrush cover for greater sage-grouse, a process to account for all of these changes in sagebrush communities is important in evaluating trends of greater sage-grouse habitat. The greater sage-grouse land use plan amendments being developed and analyzed in each sub-regional EIS in the Great Basin each have different alternative approaches to management of greater sage-grouse habitat. Alternatives propose actions that will influence the extent and distribution of sagebrush. In order to evaluate and compare the estimated effects of each alternative, a team of vegetation ecologists representing each sub-regional EIS in the Great Basin was assembled. The team used the Vegetation Dynamics Development Tool (VDDT, copyright 1995-2003, ESSA Technologies, Vancouver, BC) to accomplish this task. This modeling effort does not include changes in habitat conditions associated with permitted activities such as infrastructure development, travel management, or mineral development.

Vegetation Data

We evaluated available vegetation information developed for the Greater Sage-grouse Regional and Sub-regional efforts to identify the sagebrush habitat types

[1] Sundance Consulting Inc., Boise, Idaho
[2] USFS
[3] USFS

and associated vegetation cover classes required in our modeling effort. We determined the most effective approach would incorporate the following criteria: 1) dataset covers the entire western region, 2) the vegetation data has an associated accuracy assessment, and 3) data provides appropriate resolution of sagebrush habitat types and associated cover classes for the VDDT models. The baseline vegetation data sets developed for the region-wide Disturbance Monitoring and Vegetation Basemap Team (**) met these criteria. The datasets were developed using Landfire v12 (updated through 2010) data products and consisted of 1) existing sagebrush base, 2) conifer base, 3) potential sagebrush base (for details on methodology see Appendix – Vegetation Basemap in Disturbance Monitoring Report). In addition, we used Landfire v12 Existing Vegetation Type to identify Invasive Annual grass and Introduced Crested Seedings. Existing Vegetation Cover was used to identify sage-grouse cover class characteristics required for the modeling effort. The above datasets were combined and clipped to BLM and USFS ownership within each Sub-regional Area (Oregon, Idaho/Montana, Utah, Nevada/California) to serve as our sagebrush modeling basemaps for subsequent analysis.

GSG Habitat Characterization for Vegetation Models

We modified the sagebrush modeling basemap to facilitate characterization of sage-grouse habitat and associated development classes identified in our models. We modified the Soil Moisture and Temperature Regime data (Chambers et al 2014, Fire and Invasives Team Report, 2014) to identify 4 Vegetation Model Types – Warm/Dry sagebrush, Mixed sagebrush, Mountain sagebrush w/conifer, and Mountain sagebrush no conifer (Table 1). In addition we identified the need for a Low Sagebrush Group. We used the Landfire v12 Biophysical Settings dataset and selected low sagebrush vegetation groups (Table 2). The resulting Model Group raster was combined (raster calculator) with the Landfire Existing Vegetation Cover data to categorize the following cover classes within the Low sage [LOW], Warm/Dry Sage[WARM/DRY], Mixed Sage[MIX], Mountain Sage w/ conifer[MTN7], and Mountain sage no conifer[MTN8] (Class A = herbaceous cover 0-100%; Class B = shrub cover 10 – 30%; Class C = shrub cover >30%).To identify Annual Grass and Crested Seeding, we assigned any Landfire Introduced Upland Vegetation -Annual Grassland (evt code 3181) or – Perennial Grassland Forbland (evt code 3182) that had a sagebrush site potential to Class Invasive Annual and Class CWG Seeding, respectively. Conifer encroachment (Class D = tree cover >10%) was determined using the Conifer base dataset subset to areas with sagebrush site potential. The resulting rasters were combined, reclassified and added back to the base Model Group raster.

Soil Moisture Temperature information was limited in some higher elevation areas or shrubland-forest transitional areas. Therefore we incorporated 30 year average annual precipitation data (PRISM ppt 30yr normal 800m2 annual) to inform any unclassified sagebrush pixels in our Model Group dataset. Specifically, we set the following criteria: Average annual precipitation 14 – 28 inches =

MTN7; Average annual precipitation ≥ 28 inches = MTN8. Results were reclassified and added back to the base Model Group raster.

Additional Filters

To provide a biologically meaningful geographic extent, we filtered the final sagebrush modeling basemap to Greater sage-grouse population Areas and associated Priority Areas for Conservation (PACs) from the Conservation Objectives Team Report (USFWS, 2014). The above datasets were combined and clipped to BLM and USFS ownership within each Sub-regional Area (Oregon, Idaho/Montana, Utah, Nevada/California) to serve as our sagebrush modeling basemaps for subsequent acreage reporting and analysis.

Literature Cited

Chambers, Jeanne C.; Pyke, David A.; Maestas, Jeremy D.; Pellant, Mike; Boyd, Chad S.; Campbell, Steven B.; Espinosa, Shawn; Havlina, Douglas W.; Mayer, Kenneth E.; Wuenschel, Amarina. 2014. Using resistance and resilience concepts to reduce impacts of invasive annual grasses and altered fire regimes on the sagebrush ecosystem and greater sage-grouse: A strategic multi-scale approach. Gen. Tech. Rep. RMRS-GTR-000. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Greater Sage-grouse Disturbance Monitoring and Vegetation Basemap Assessment Team Report. 2014 Greater Sage-grouse Wildfire, Invasive Annual Grasses and Conifer Expansion Assessment FIAT Report. 2014.

Miller R. F; Chambers, J. C.; Pellant, M. 2014a. A field guide to selecting the most appropriate treatments in sagebrush and pinyon-juniper ecosystems in the Great Basin: Evaluating resilience to disturbance and resistance to invasive annual grasses and predicting vegetation response. Gen. Tech. Rep. RMRS-GTR-322. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Miller R. F.; Chambers, J. C.; Pellant, M.[In press]. A field guide for rapid assessment of post-wildfire recovery potential in sagebrush and pinon-juniper ecosystems in the Great Basin: Evaluating resilience to disturbance and resistance to invasive annual grasses and predicting vegetation response. Gen. Tech. Rep. RMRS-GTR-###. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

U.S. Fish and Wildlife Service [USFWS]. 2013. Greater sage-grouse (*Centrocercus urophasianus*) conservation objectives: Final Report. Denver, CO: U.S. Fish and Wildlife Service. 91 p.

U.S. Geological Survey (USGS). 2013: LANDFIRE 1.2.0 Existing Vegetation Type layer. Updated 3/13/2013. Washington, DC: U.S. Department of the Interior, Geological Survey. Online: http://landfire.cr.usgs.gov/viewer/. [Accessed 10 July 2014].

Table 1 – VDDT Model Groups associated with predominant sagebrush ecological types in Sage-Grouse Management Zones III, IV, V, and VI based on soil temperature and soil moisture regimes, typical characteristics, and resilience to disturbance and resistance to invasive annual grasses (modified from Chambers et al. 2014, Miller et al. 2014 a,b).

Ecological Type	Characteristics	VDDT Model
Cold and Moist (Cryic/Xeric)	Ppt: 14 inches + Typical shrubs: *Mountain big sagebrush, snowfield sagebrush, snowberry, serviceberry, silver sagebrush, and/or low sagebrushes*	MTN8, LOW
Cool and Moist (Frigid/Xeric)	Ppt: 12-22 inches Typical shrubs: *Mountain big sagebrush, antelope bitterbrush, snowberry, and/or low sagebrushes* Piñon pine and juniper potential in some areas	MTN7, LOW
Warm and Moist (Mesic/Xeric)	Ppt: 12-16 inches Typical shrubs: *Wyoming big sagebrush, mountain big sagebrush, Bonneville big sagebrush, and/or low sagebrushes* Piñon pine and juniper potential in some areas	MIX, LOW
Cool and Dry (Frigid/Aridic)	Ppt: 6-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush, and/or low sagebrushes*	WARM/DRY, LOW
Warm and Dry (Mesic/Aridic, bordering on Xeric)	Precipitation: 8-12 inches Typical shrubs: *Wyoming big sagebrush, black sagebrush and/or low sagebrushes*	WARM/DRY, LOW

Table 2 – Landfire 120 Potential Vegetation Types identified for the Greater Sage-grouse LOW Sagebrush model.

BPS Value	Landfire Potential Vegetation Type
10640	Colorado Plateau Mixed Low Sagebrush Shrubland
10650	Columbia Plateau Scabland Shrubland
10790	Great Basin Xeric Mixed Sagebrush Steppe
11240	Columbia Plateau Low Sagebrush Steppe
11262	Inter-Mountain Basins Montane Sagebrush Steppe - Low

Datasets Used in the Vegetation Analysis

From Disturbance Monitoring and Baseline Vegetation Teams (Spring 2014)

Landfire 18 Class EVT (Current) related to sagebrush systems [dataset: lf_evt_v12_sagebrush_recode]

Landfire BPS (Potential) Associated with the 18 Class EVT above [dataset: lf_bps_v12_sagebrush_recode]

Binary Landfire 18 Class informed w Dev/Ag/Fires/Conif-sage [dataset: 2010_existing_sagebrush_base]

Binary Conifer in Sage (near neighbor analysis w/ State bio acceptance) [dataset: lf_evt_v12_conifers_binary]

Data from Fire/Invasives (FIAT) Team

SSURGO Soil Temperature/Moisture Regimes (Chambers et al 2014)

[dataset: SGMZ_SSURGO_temp_moist_regimes_v2.gdb]

Additional Spatial Data

Landfire Annual Grass Only [dataset:]

Landfire EVC (Cover) associated w/ the above Landfire Binary Sagebrush Basemap [dataset: US_120_EVC]

PRISM [dataset: PRISM_ppt_30yr_normal_800mM2_annual_bil]

Management Scale Information Filters

GSG PAC Boundaries [dataset: GSGCOT_ALL_PAC_Atts_Albers_Dis_2014]

GSG Population boundaries [dataset: COT_SG_Populations_2014_WAFWA_UT]

Subregional EIS Boundaries [dataset: EISSubmittedBoundaries_mrg_dis]

State Boundaries [dataset: States5_ESRI_2008_Albers]

Surface Mgmt Boundaries (including FS Forests/Districts; BLM District/Field Offices) [dataset: SMA_Dec2013_Monitoring_AOI_cli]

BLM – Subset: Agency: BLM, DOE, DOI, OTHFE

USFS – Subset: Agency: FS, USDA

USFS – For USFS Forest Name [dataset: USFS_GRSG_FS_Boundaries_Aug262013_Dissolved]

Utah specific to inform COT PAC and COT POP [dataset: UT_AltF_VDDT]

COT Population Unit Number - (ver. 07232014) for GSG VDDT Analysis